A

DISQUISITION

ON

PESTILENTIAL CHOLERA;

BEING AN

ATTEMPT TO EXPLAIN ITS PHENOMENA, NATURE, CAUSE, PREVENTION, AND TREATMENT, BY REFERENCE TO AN EXTRINSIC FUNGOUS ORIGIN.

BY

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TO

JOHN FORBES, M.D., F.R.S., &c., &c.,

(AND TO THE MEDICAL PROFESSION, WHICH HE HAS FOR THE LAST TWELVE YEARS SO SUCCESSFULLY STRIVEN, BY HIS PUBLIC LABOURS, TO EXALT AND IMPROVE)

THIS LITTLE WORK IS DEDICATED,

(BY PERMISSION,)

IN TOKEN OF ESTEEM AND RESPECT,

BY THE AUTHOR.

PREFACE.

In the publication of a new book on Pestilential Cholera, some explanation is felt to be due to the medical reader, which will, perhaps, be best conveyed in a short statement of the history of this little work. On the announcement of the appearance of Cholera off our coast (at Falmouth), the author was induced to refresh his knowledge of that disease, by taking a review of the writings he possessed on the subject. In this examination he was struck with an analogy, apparently existing between the origin, and phenomena attending the course, of Pestilential Cholera, and some other natural phenomena, constantly occurring before our eyes. The enquiry was pursued; and the result satisfying the author, that by it useful light might be thrown upon this hitherto confessedly obscure subject, he

felt that publicity ought to be given to it, which at any other time than the present, and now even had the subject been one of comparatively little importance, might have been effected by reading a paper before one of the medical societies, or by condensing his argument into the compass which would have rendered it admissible into one of our periodicals. But under present circumstances neither method seemed eligible; the former would not have afforded sufficient publicity to render it extensively useful; the latter would have demanded such a degree of curtailment as would perhaps have weakened the argument, and have rendered its reception more difficult.

The author, moreover, believes that it is totally different from the many works that have preceded it,—a consideration, that diminishes his reluctance to send it to the press.

Liability to error there must be in every work based, like the present, on the statements and observations of others; the most that can be done to avoid this, is to select from writers of approved reputation,—and, on contested points, to choose that which appears most in conformity with known

facts, and supported by authority most worthy of reliance; — this the author has endeavoured to do.

Some acknowledgment is felt to be due to those gentlemen, of whose works such free use has been made in the composition of the following pages; and in tendering to them, one and all, his expressions of grateful obligation, the author ventures to hope that, in the event of confirmation being supplied by future investigation to the doctrine herein advanced, they will be glad to have rendered much efficient aid in developing his views.

Finally, in committing this work to the criticism of a learned profession, the writer may be permitted to say, in extenuation of its many faults, that he has had but few opportunities for the preparation of a completer treatise; and the emergency seemed to him to require its hasty preparation. For the last ten years shut within the walls of a small country town, not supplied with a medical institution of any kind—even a library, his only resources were to be found on his own book-shelves: neither leisure nor opportunity allowed of his making use of the abundant materials stored up in metropolitan libraries.

This, however, he is compelled in candour to confess, causes him the less regret, as he relies more on the scientific support of his hypothesis, than he would on any mass of harmonising opinions or concurring circumstances.

Scarcely aspiring to be placed in the rank of discoverers in the useful science of medicine, the author contents himself with the hope of having with a few rude poles and planks constructed a scaffolding, from which skilful workmen can ply their industry and ingenuity in erecting a more finished and substantial structure.

Oundle, Northamptonshire,
January 29th, 1848.

CONTENTS.

CORRIGENDA.

Page.	*Line.*	
8	1	for "Copeland," read "Copland."
15	5	"symtom" read "symptom."
21	10	do. do.
21	11	"disarrhæa" read "diarrhæa."
21	14	"symtom" read "symptom."
22	19	do. do.
23	13	do. do.
58	8	"subsidary" read "subsidiary."
94	26	"medica luses" read "medical uses."
137	20	"enoculation" read "inoculation."
143		reference, for "p. 1 0" read "p. 140."

PESTILENTIAL CHOLERA.

PART I.

INTRODUCTION.

The nature and cause of the Pestilence, of which we are about to treat, are acknowledged by the most recent[1] writers on the subject to be enveloped in mystery,—or rather obscurity; for we are unwilling to admit mystery among the circumstances, attendant upon the results of natural causes. In the study of this disease the author discovered, as he thought, an analogy between the origin and progress of it and the phenomena accompanying the development and diffusion of the lowest orders of the vegetable kingdom; and he was led to conceive that there might indeed exist an identity between the virus, or materies morbi, of Pestilential Cholera and the germs of some low Cryptogamic organism. The conception was pursued;

[1] Dr. Parkes speaks of it as a "mysterious disease" in his work on 'Asiatic or Algide Cholera,' published since the materials for this were prepared.

and an argument from analogy has been constructed, the success of which it must be left for the reader to determine.

In the present state of conflicting opinions on this Pestilence, it requires much confidence in the truthfulness of any new view of its nature and cause, as an inducement to write upon it: but on glancing at the list of authors—some of the highest eminence—who have written upon it (the number of works on this disease, enumerated in the Bibliographical References at the end of the article 'Choleric Pestilence' in Dr. Copland's Dictionary, is 90), and finding such a marked want of unanimity in their estimation of the cause, mode of propagation, and necessary treatment, such confidence should be tempered with humility.

It is, however, believed that some advance has been made, by this attempt, towards placing the pathology and treatment of Pestilential Cholera upon a philosophical basis, supported by the most accredited views of modern physiology and of physiological and pathological chemistry. Indeed, in prosecuting this enquiry, no little astonishment has been felt at finding the new doctrine so generally compatible with the observations and opinions of almost all, who have had facilities for investigating this disorder, mingled with much gratification, on discovering that it has comparatively a clear course to walk over, being unopposed by any other theory equally well supported. Should the doctrine be established by the confirmation, which, in the event

of another visitation, the microscope and test tube, but chiefly the microscope, would,—if it be true—probably be able to render it, a fixedness would be given to the view of the pathology of Cholera, and a steadiness to its treatment, the want of which has added to that disease much of its present terribleness.

But little has been done hitherto towards elucidating the etiology of Pestilential Cholera, as much obscurity appearing to becloud the subject, as in the days of Sydenham, who seemed to deem it presumptuous, in the highest degree, in any one, to enquire what was the proximate cause of any particular pestilence. And, as criticism forms no part of the plan of this little work, we shall do no more than just mention some of the notions of the pathology and cause of this disease, entertained by deservedly esteemed writers. By one the disease has been supposed to consist in inflammation of the stomach and bowels; by another, to resemble a severe form of ague; by some, to depend upon a morbid state of the nervous system, and even to be analogous to tetanus; while many attribute much importance to the inflamed state of the lungs,[1] or to the seemingly paralysed condition of these organs. Then as to the cause; some still ascribe the disease to conditions purely atmospheric; an animal effluvium, or poison, is assumed by others; and one ingenious hypothesis

[1] Dr. Parkes thinks the morbid state of the lungs forms the most important feature in the pathology.

has suggested its connection with the migration of insect swarms. But, thanks to those, by whose laborious study the sciences of Physiology and Chemistry, and, hence, by consequence, that of Pathology, have lately so rapidly advanced, we may hope ere long to see our way through many of the intricacies and obscurities, besetting some of our most formidable diseases, and most of all those called Pestilences. And the author will feel repaid, should he have been able to throw any light upon this dark portion of the field of medical study, whereby some more able, and more ardent in the pursuit of knowledge, shall be put upon the right track.

The present is not an attempt to build up a hypothesis on any preconceived views, with which facts are to be strained into an apparent compliance; but an endeavour to construct, upon a legitimate induction from facts, an argument from what is acknowledged, to that, which is still a subject of dispute; an analogy is thereby found to exist between certain familiar operations of nature and some of those more obscure performances, with whose manifestations we are daily made conversant in the treatment of disease. But while constrained to admit, that an argument from analogy is imperfect, and by no means sufficient to a demonstration of truths, yet, just as the analogical reasoning of Newton was powerful in his hands in unfolding to our view the harmonious construction of the universe, of which our planet forms so small a

part; and, as Butler, by similar means, exhibited the links of connection between science and religion; so may this method be fairly employed by us in establishing the dependence of phenomena, presented to our observation in pestilences, and especially in Pestilential Cholera, upon a known and natural agency. This argument,—should it not convince the reader of the truth of the view, we are about to promulgate,—may be of use in directing the minds of others to a discovery of the truth. Were it supposed by the writer, that his speculations had a tendency to widen the gulph, which appeared to old authors, as Sydenham, and to modern ones, as Hecker, to separate the phenomena of pestilences from the dominion of natural causes, he feels that it would become him to view his work with extreme distrust; but to his mind it seems, that, by such speculations, the more obscure operations of disease may become explicable in a simple and rational way, and may even eventually become demonstrable, as other scientific phenomena. It is of this simple and rational nature (and which will, it is hoped, hereafter become demonstrable), that the exposition, by argument from analogy, contained in these pages, will be found to partake,—the facts and arguments tending to throw light on the hitherto hidden cause of pestilences, and consequently to bring these under the influence and control of scientific management.

As regards the arrangement and division of the

subject; it was, at first, thought, that it would be best to give an abstract of the information, we at present possess on the History, Nosology, Nature, Cause, and Treatment of the Disease, accompanied by a running commentary, embodying the author's views; this plan has, however, given way to the present, in which we shall rapidly glance at the various parts of the subject in the order enumerated, and reserve for a second and distinct part our own argument, in this way keeping the speculations of the author distinct from the chapters, compiled from the writings of practical men; by which means the reading of the book will, it is hoped, be rendered smoother, and the confusion of the author's arguments with the statements of others will be avoided.

CHAPTER I.

HISTORY OF PESTILENTIAL CHOLERA.

The chapters, forming the first part of the book, and containing an abstract of the knowledge possessed, up to the present time, on the subject of each title placed at their head, will be found to have been compiled chiefly from the writings of two physicians, who may be supposed pretty fairly to represent their several parties,—the one advocating the opinion of the Contagionists, the other supporting that of the Non-contagionists. The object of this part, being to convey to the reader so much information on the subjects treated in the five chapters, of which it consists, as shall be needful to an intelligible connection of the succeeding argument with the known facts of Pestilential Cholera, it has been deemed sufficient for our purpose to confine our descriptions (with very few exceptions) to the extracts we have drawn from the articles 'Pestilence, Choleric' in Dr. 'Copland's Dictionary of Practical Medicine,'—and 'Cholera,' by Dr. George Budd in the 4th volume of the 'Library of Medicine,' edited by Dr. Tweedie.

A difference of opinion exists as to the date, and, therefore, as to the place, of the origin, of Pestilential

Cholera. By Dr. Copeland it is understood to have made its appearance as a *new* disease at Jessore, a populous town on the Delta of the Ganges, in 1817; whilst Dr. George Budd, on the authority of Mr. Curtis and others, says, "there is reason to believe that this pestilence existed in India, showing itself, however, only occasionally, and in districts of limited extent, for a long time before it became diffused over Asia and Europe"; and, he states, that it prevailed in Madras in 1774; at Hurdwar in 1780, destroying there 20,000; that in 1781 it assailed, in its most malignant form, some Bengal troops, stationed at Ganjam; and spread through Sir Edward Hughes' squadron in the east, in 1782. In the Madras reports it is said to have visited Arcot in 1787. He also quotes from a communication of Mr. Barnes, medical superintendent at Jessore, that, previously to its outbreak at Jessore in 1817, it had twice prevailed there.[1]

Here, however, it assumed a severe form of malignancy in 1817, and from hence spread its ravages eastward throughout India. In 1818 the Pestilence proceeded, in a more southerly direction, along the coast of Coromandel; thence to Ceylon; and in the same year it appeared in the Mauritius. In 1820 it showed itself in the northern parts of China, the Philippines, &c.; in 1821, Java, Borneo, and other

[1] Dr. Parkes, the most recent writer on the subject, says, p. 241, "the first epidemic was observed in these provinces" (of Tenasserim).

places felt its ravages; and in 1822, 1823, 1824, it prevailed fatally in Tonquin, Pekin, Central and Northern China, Macassar, Assam, the Spice Islands, and various other countries. In June or July 1821, it had made a westerly progress as far as Muscat in Arabia, simultaneously assailing the islands at the mouth of the Persian Gulf, and appearing at the principal British mart in Persia,—Bendir Abouchir. It also penetrated inwards, and reached the Persian capital. Passing through Arabia and Mesopotamia, we at length find the disease doing its mortal work at Bagdad, and extending as far as the desert, separating Mesopotamia and Syria. Here we pause in our narrative, for the Cholera as it were, rested at this point, whether stayed by the uncommunicative nature of the wilderness, or by cold, or what other cause, can be mere matter of conjecture. Next spring (1822) it revived, and, proceeding towards Syria, reached Aleppo in the decline of the year, again to subside. In 1823 it resumed its westerly course, coasting along the shores of the Mediterranean, but stopping short of Egypt. When the disease prevailed in Ispahan in 1821, on the approach of winter, it disappeared; but reappeared, on the return of spring, in the centre of Persia. The shores of the Caspian Sea were visited by it in 1823; and it had arrived at Astrachan by September of that year.

Here the pestilence came to a long halt, not making any way westward for about five years. In 1828

the confines of Russia in Europe were passed by it. Orenburg, a town situated on the very outline of Europe, and having commercial communications with Upper Asia, was invaded; and the disease again abated its ravages during the winter months. At this time it was also ravaging Persian and Tartar provinces in Central Asia. In 1830, traversing the shores of the Black and Caspian Seas, it rapidly strode into the centre of Russia, and Moscow was visited in September. Here, contrary to its wont, it continued to rage *through* the winter; hence it was diffused in 1831 over the Russian provinces, appearing at Archangel and St. Petersburgh, and extending itself throughout Poland, Prussia, and Germany. Following the Russian army in the subjugation of Poland, it made fearful havoc in towns of that country in 1831. In May of the same year (1831) it broke out in Dantzic; in June at Lemberg and Cracow; thence stretching across Gallicia and Hungary to reach Berlin in one direction, and Vienna in another, by August and September. This month (September) saw it at Smyrna; and it soon after appeared at Constantinople. A caravan conveyed it to Mecca, where it broke out in May 1831, and was very destructive among the pilgrims. In August, Alexandria, and, nearly simultaneously, all the places in the Delta of the Nile, were assaulted.

In October of this same year (1831) Sunderland, on our own shores, received its contamination; by

January, 1832, it had extended to Edinburg; in February of that year it was in London, and soon afterwards in many English towns. During the summer of 1831, we find it prevailing on the continent—in France, Holland, Spain, &c. In June it had established itself in Quebec, and rapidly pervaded the provinces of the Canadas and States. Here it was disseminated a year or two before Sweden suffered from it, and twice as long before it had arrived in some of the Southern States of Europe. Dr. George Budd to whose account I am indebted for much of this historical sketch of the progress of Cholera adds,[1] "its principal advances have been made in the summer, and it has entirely subsided, or remained *almost* stationery during the months of winter."

* * * * *

"In this gradual diffusion over the civilized world, it has overcome obstacles that have hitherto been sufficient to stop the progress of the plague,—it has traversed the Ghauts and the Caucasus; the sandy deserts of Arabia and Persia; the Indian and Atlantic Oceans. It has existed under the most various conditions and elevations of soil, temperature, and moisture;—at the level of the sea, and in the region of Nepaul, at a height of not less than 5,000 feet above it; on the borders of the ocean, and in the centre of continents; during the summer heats of the

1 'Art. Cholera in Lib. of Med.' by Dr. George Budd.

torrid zone, and the rigours of a Russian winter; on the arid soils of Arabia and Persia, as well as in the marshy deltas of the Ganges and the Nile. It has made its way against the winds in Europe and the monsoons in the Indian Ocean."

The disease has always shown a preference for low, damp, and dirty localities, and the poor inhabitants of such have formed the most numerous class of sufferers; but it has not confined its attacks to any locality or any class; nor has one visit to a place, nor one attack in an individual, uniformly procured an exemption from its repetition. Since the time of its outbreak in 1817, at Jessore, to the present, though its ravages have been partial, India has never been thoroughly free from it; scarcely a year having elapsed since that period without its manifesting itself in Bombay and Madras. Other Asiatic empires, too, have been subjected to repeated visitations. England was visited in 1832, 1833, and 1834; since which time, till the present year, it has been exempt, with the exception of a few cases in the Marylebone Infirmary, and in a vessel (the Dreadnought) on the Thames in 1837.

But it appears now (December, 1847) to be proceeding by its former route in its progress towards us. It is already extensively prevalent in Gallicia,—from which country, in 1831, it occupied only four months to pass to England, having been at Cracow in June, and breaking out at Sunderland in October. The reported existence of some cases on board a vessel off

Falmouth, and the rumour within these few days of some cases in London, may serve for warnings to us, that we ought to prepare ourselves for what *may* be announced to-morrow. Some such urgent appeal, as that of Sir Gilbert Blane published in 1831, might, with much probable good, be widely circulated.

Having rapidly sketched the progress of Pestilential Cholera, we turn for a sickening glance at its mortality. At Jessore in 1817, it is stated by Dr. Copland, that the majority of those attacked were cut off; and by Dr. George Budd it is said, the number of deaths in six weeks was reported as 6,000, and in two months it numbered 10,000. In its diffusion through the states of Asia, China, and Tartary, the attendant mortality is stated to have been unprecedentedly large. In the Mauritius, too, its fatal ravages were very extensive. In its visit to Orenburg, it swept off one-fourth of the total number attacked. In the renewed assault on Astrachan, in one month upwards of 25,000 died of it in the city and province. More than one-half of the cases occurring in Moscow had a fatal termination. In Cairo more than 10,000 Mahommedans, besides Jews and Christians, were cut off by this pestilence, in the months of August and September, 1831. It has been reckoned that, in thirteen years, 18,000,000 of souls were cut off in India from a population of 40,000,000. No strict register of deaths was kept in many Asiatic towns and provinces; but wherever it appeared, its

mortality was very great; and in some places, it is supposed, one-third of the inhabitants fell victims of the disorder. In Russia 60,000 persons died of it in 1831. In Paris alone in 1832, 18,000 fatal cases are reported to have occurred. Dr. W. Merriman, in a table extracted from the reports sent to the office of the Privy Council, gives about 20,000 as the number of deaths in England and Wales, the number of attacks up to March, 1833, having been 62,000, and of recoveries 42,000. In Ireland it was attended by a mortality somewhat higher,—in upwards of 54,000 cases there were 21,000 deaths and 33,000 recoveries, in round numbers. But, in estimating the numbers attacked and carried off by Pestilential Cholera in Great Britain, Dr. Copland states his belief, and furnishes supporting facts, that not even an approximation to the truth was obtained; for that, to his own knowledge, several fatal cases of it were not reported, and many cases, that had been checked in the earlier stage, were either not regarded as cases of cholera, or at least were not returned as such.

CHAPTER II.

NOSOLOGICAL DESCRIPTION.

In an appendix to Cullen's Practice of Physic by Dr. Gregory,[1] we read a description of the Pestilential Cholera, which leaves us without doubt, that an actual visitation of that terrible disease was not needed, to convince us, that its symtoms differed very much from those of our English Cholera; and, that practitioners might have been prepared to contend with a mortal enemy, hitherto unknown to them. Dr. Gregory remarks, "that there is an obvious affection of the nervous system, appears from the violent spasms of the extremities, and even of the trunk, often observed to precede the evacuations; and in its most dangerous form, the Cholera (which has at different times, but particularly lately, been most extensively and fatally prevalent in India and other tropical countries,) has been sometimes observed to prove fatal *without any vomiting or purging*, in the course of a very few hours; or even, in a few instances, to prove *immediately destructive to life*. There is manifestly, also, an

[1] 'Op. Cit.' edited by Dr. Gregory (Edinburg, 1829), vol. ii., p. 371.

uncommonly great and sudden alteration of the circulation and distribution of the blood, as shown by the rapid shrinking and coldness of the surface, the clamminess and lividity of the skin, the collapse of the features, the sinking and glassy appearance of the eyes, &c., along with great and sudden diminution in the strength of the pulse, which is often imperceptible for a considerable time before death; and further indicated by the enormous quantity of fluid discharge which takes place, in most cases, from both the stomach and bowels, within a short time after the commencement of the disease." The difference between the disease, thus ably portrayed some years before its introduction into this country, and our own well known Cholera, will be sufficiently obvious from a comparison of the above extract with Dr. Cullen's definition of the latter in the same work;—[1] "Humoris biliosi vomitus, ejusdem simul dejectio frequens; anxietas; tormina; surarum spasma." Enough has been said to show, that it was not, at any rate, for lack of knowledge to be found in English medical works, that many practitioners were confessedly led into the mistake, of regarding the disease of India, till they saw it at home, as a severe grade of our sporadic Cholera. And yet, great as are the differences between the two diseases, and important as it must be considered, for practical purposes, to keep in view

[1] 'Op. Cit.' vol. ii., p. 131.

a clear conviction of such differences, it may be fairly disputed, whether there be not as strong an affinity between them, as we find between pure inflammatory fever and adynamic typhus, the one under aggravating circumstances degenerating into the other. All, therefore, that can be insisted on is, we think, that the two diseases are distinct species or varieties, and not mere gradations of one disease. We shall have occasion to supply evidence in support of other statements in the work, which would, if introduced here, tend to confirm this opinion.

But, however readily we may concede, that the Pestilential Cholera is not a grade of our own indigenous disease; it will be far more difficult to admit the view, apparently entertained by Dr. Copland, that it is a *new* disease, even in Asia. Indeed, had we not the statements of Dr. George Budd, who has satisfied himself of the identity of the disease, lately witnessed, with that which prevailed in India towards the close of the last century, nor the testimony of Mr. Barnes, as to the appearance of the pestilence in Jessore, twice, before 1817, analogy, supported in some degree by history, would forbid us to adopt this notion of *newness*. Sydenham has well directed attention to the diversities of diseases, constantly manifested in their successive epidemic visitations; and his remark on the epidemic *English* Cholera of 1669, which, he says, was unusually prevalent and severe, is to the same purpose. The variations he attributed to un-

known causes; which he frequently adverted to, as "the constitution of the air," "the pestilential constitution," &c. Now Sydenham's Epidemic Cholera of 1699 (which Dr. Swann, the editor of an old English edition of Sydenham's works, in a note, says, was only equalled in its mortality by the plague) was probably as diverse from our common sporadic Cholera, as is the Pestilential Cholera of India from the common Cholera of that country:—the superadded infectiousness, if it existed in either instance, is not sufficient proof of a generic distinctness between these apparently allied affections. Diseases, almost universally believed to be infectious or contagious (words in the present day generally, and therefore in this book, employed synonymously), most frequently lie dormant in certain confined localities, and only occasionally burst their bonds and extensively pervade districts; this we see in malignant typhus fever, as is ably stated in regard to that disease by Dr. Christison[1];—and in the 'Plague'[2] we have another instance of the same thing;—so it seems probable, that Pestilential Cholera may have been ordinarily known, within a few limited localities, in tropical countries of the eastern world, and may, after a long period of inactivity, have been aroused by peculiar circumstances. It seems to us unphilosophical to deny to Cholera the

[1] 'Lib. of Med.,' vol. i, p. 155.

[2] 'Sydenhami Opera,' by Dr. Greenhill, for Syd. Soc., p. 98, "quin pestilentiæ morbum, *alicubi semper superstitem*," &c.

power to extend itself beyond its accustomed geographical boundaries, when another pestilence is known to be possessed of it. May it not be rationally inferred, therefore, that a disease indigenous, for the most part, to eastern countries, and exotic to all others, might on some occasions, when the condition of these last had become in some way favourable to its extension, be tempted to traverse them? instead of being compelled to admit that this circumstance, coupled with the supposed contagiousness, indicated in the Pestilence a disease, totally new. We shall presently see on what ground the argument for the newness rests, as regards the pathological indications.[1] We have the support of ancient and modern authority in concluding that, as our ordinary pestilences do much vary in their gradations of severity, and even in their characteristic symptoms, in their successive visitations, so, it is at least probable, that Pestilential Cholera, as like that of the epidemic of 1831 and 1832, as any one epidemic of Plague, or malignant fever, is to its immediate predecessor or successor, had existed before 1817; and that the additional phenomenon of rapid communicability, and the consequent penetration of Cholera into every division of the globe, only resembles, what takes place in Plague and other

[1] Dr. Parkes who has witnessed the disease in its malignant form in India, says, p. 46, *note*, "The question of identity of the two diseases" (epidemic and sporadic Cholera), "is still a doubtful point, although the probability is in favour of the identity."

diseases, and, therefore, cannot be accepted as evidence of newness of the Pestilence. The same objection may be urged against the sufficiency for proof of the aggravated form of the disease, and its high rate of mortality. The following extracts from the works of Sydenham, so lately published in a handsome form by the Sydenham Society, will bear us out in the use we have been making of his authority. Of the Plague, and its gradations of severity, he says,[1] "Aëris massae occultam ejusmodi sive crasin, sive texturam obtingere, quae diversarum diversis temporibus aegritudinum ansa atque pararia existat, nemini obscurum est, qui modo animadverterit unum eundemque morbum certa aliqua tempestate infinitam mortalium vim corripere, ac epidemicum fieri; alias tamen unum alterumve hominem afflixisse contentum, ulterius non grassari. De variolis ac imprimis de Peste, hujusce capitis argumento, res est sat superque manifesta." A parallel instance in the case of English Cholera, already adverted to, he mentions thus,[2] "Morbus hic, qui (ut antea diximus,) anno 1669 se latius diffuderat quam alio quovis anno, quantum ego observaveram, &c."

From these prefatory observations we proceed to a detailed account of the symptoms of Pestilential Cholera, as observed by practitioners in England, in India, and other parts.

[1] 'Syden. Oper.,' by Dr. Greenhill, p. 96.

[2] 'Op. Cit.,' p. 163.

Symptoms of Pestilential Cholera.—These almost always first appear *between sunset and sunrise* (Dr. George Budd).

1st,—In such cases as are preceded by a premonitory stage (which is reported by many writers to have occurred in a considerable proportion of those attacked), there is a shrunken, pale and anxious expression of countenance; while the subject of it is often affected with giddiness, tinnitus, headache, and, perhaps, with the usual symtoms of ordinary dyspepsia and disarrhœa; blackness around the eyes is also, generally, a conspicuous precursory appearance.

2nd,—In a more advanced stage (or in a severer grade not so preceded), the symtoms are perfectly similar in kind, though they are of a less intense degree of severity, than in the next stage; and, as we do not see any great utility in multiplying divisions, we shall at once proceed to a description of the next.

3rd,—This is in fact a manifestation of the Pestilence in all its dreadful characters; it may have stolen on from premonitory steps or not, some being suddenly struck down without the slightest warning. The patient will suffer from giddiness; noise in the head; great agitation and alarm; oppressed breathing; deprivation of muscular strength; spasms of the extremities, rapidly reaching the trunk, but seldom affecting the muscles of the back, loins, or face; the belly of a muscle is often drawn, as it were, into a hard knot, and then for a few seconds relaxes; in some instances, the spasms occur, without being

either preceded, or succeeded, by the vomiting and purging, but generally these discharges precede the spasms.[1] The evacuations, by vomiting and stool, are in some cases very profuse, and forcibly discharged, but without apparent *voluntary* effort; they, at first, contain the ordinary contents of the alimentary canal, but soon assume the characteristic appearances, and consist of a peculiar, faintly odorous, whitish liquid, familiarly known as "the ricewater evacuations"; these again in some protracted cases, under the observation of Dr. George Budd, "assumed a peculiar character, which was apparently owing to the presence of the colouring matter of the blood." The pulse is during this time small, thready, and easily compressible; the countenance shrunk and dejected; the eyes sunk and surrounded by a livid circle, and described by Dr. Copland as presenting a "wild and terrified look arising from a feeling of rapid dissolution."

If the above symtoms be not checked, they advance in severity; there will be extreme prostration of strength;—a dry, glaring appearance of the eyes which are now still more sunken; the nose, lips, and extremities are leaden blue and icy-cold; the tongue is pallid, or blue, cold and often covered with white mucus; the breath is also cold; the pulse is nearly or even quite imperceptible; the hands and feet—at least their palms and soles,—are shrunk and sodden

1 Some think the spasms are produced by the matters poured into the alimentary canal, and there irritating the excito-motory nerves.

"like the fingers of a washerwoman," the fingers and toes being retracted "like bird's claws"; there is an intolerable burning heat at the præcordia, and in the region between the epigastrium and umbilicus,—with burning thirst and craving for cold drink; the voice is feeble and hoarse, faltering or gone; the secretions—urinary, biliary, salivary—are all suppressed. The dyspnœa increases to great oppression, and is high and quick; extreme jactitation now attends the symptoms, in the midst of which the intellect of the sufferer remains unclouded—though indolent, and the memory, when aroused, clear and distinct. If these distressing symtoms do not receive speedy mitigation, they must rapidly run on to a close; in this case, the breathing will become most laborious, irregular, and imperfect, each breath being inspired with a great effort, and expired again so quickly as almost to make it appear convulsive; the pulse now has ceased to be sensible; the voice is reduced to a whisper, in which the patient can utter but a word or a syllable at a time; he struggles and throws about his arms, often applying them to his chest and stomach, to which regions he refers his greatest suffering; the large veins on the surface present the appearance of dark flat lines; the skin is shrunk, shrivelled, sodden, deadly cold and raw to the touch. The sense of touch is stated by Dr. Copland to be in general greatly blunted; and most agree that the sense of hearing is also much obtunded. Some time before death the

spasms and evacuations subside; and *immediately before that event the temperature of the body often rises, and continues to do so even after death.* A thermometer placed under the tongue, in the cold stage, indicates a temperature diminished in some cases as much as 10° or 12° below the natural standard. If blood be drawn in the cold stage, it can only be procured drop by drop, and is described as being "thick and tarry," "viscid," "oily," "glutinous," and often it will not flow at all. The skin is said to exhale a peculiar earthy odour, and is often bedewed with an abundant clammy cold perspiration. If the symptoms are yielding to remedial measures, the temperature and colour of the skin, together with the increased fulness and strength of pulse, indicate the improvement; while, if the disease is not controlled by the treatment, the failing functions rapidly carry the victim onwards to his fatal destiny. The lips and cheeks puff out; and there is sometimes at last a quivering of the tendons of the extremities. The patient, though sensible almost to the last, appears little anxious for recovery, but desires to be left to his fate; he becomes weaker and weaker, cannot swallow, falls into a state of unconsciousness, sobs convulsively, and dies. In some of the most rapidly fatal cases convulsive muscular twitches continue hours after death.

Such is the picture, drawn by most able hands, of the course and issue of those cases, in which reaction

and rallying are not seen to occur. These bring down their victims in a few hours,—rarely exceeding twenty-four. From the state, above depicted, but few recover, even when assisted from the onset of symptoms by medical skill; and yet fewer, when the disease has stolen a march of a few hours upon the treatment. According to an experienced observer, from whom we have largely quoted, the disease seldom yields to treatment, when the pulse can no longer be felt at the wrist. While, on the other hand, when death has threatened to put a period to the sufferings and the being of the patient together, the appearance of hiccough is a cheering symptom, as an announcement of returning circulation.

In milder forms of the Pestilence, the pulse is never so much weakened, the breathing not so heavily oppressed, though it may have been that the evacuations in both ways have been exceedingly profuse, and the spasms proportionably severe. Dr. George Budd agrees with Dr. Copland, that shivering is a rare symptom in the course of Pestilential Cholera.

When death does not cut off the patient in the cold stage,—the discharges abate or cease; the warmth increases; the pulse regains strength; the colour improves; the extreme oppression is relieved; the secretions reappear;—in fact reaction takes place; and the sequel of the disease may be either, first, a short passage through the debility of convalescence to renewed health, without intercurrent inflammation or other accident,—the issue of mild cases; or, secondly, a continuance of gastric and intestinal irritation may

invalid the patient for days, weeks, or months; or, thirdly, a reactive fever, presenting a malignant type, succeeds, again to jeopardise the patient, and probably to realise for him the fatal effects of this mortal disease. This fever is of a typhoid nature;—the cheeks flushed; the conjunctiva suffused; the tongue red and dry;—stupor and somnolence, low delirium, and subsultus, completing the character. Not unfrequently there appears a minute papular eruption, but there is little heat of skin or quickness of pulse. Such is Dr. George Budd's account of this dangerous sequela of Pestilential Cholera.

The numerous accounts of this Pestilence in India, and the reports of Drs. Barry and Russell, agree in representing this typhoid fever as a by-no-means infrequent consequence of Cholera. Dr. Reimer reports, that, of twenty fatal cases under his care, seven died in the stage of collapse, and thirteen in the consecutive fever. In two cases, attended by Dr. Copland, extensive erysipelas complicated the fever. All agree, likewise, in the fact that dysenteric affections, not uncommonly (and more particularly in India), render the patient's convalescence painful and tedious,—not to say, dangerous.

The choleric fever is described as presenting all the adynamic appearances of pestilential typhus fever. There are headache and tinnitus, which, if the disease continues, run into stupor; drowsiness; and, eventually, delirium; the pupil is dilated; then the eyes become suffused, and the conjunctiva dusky; the face

is flushed, and the countenance heavy and stupid, as in typhus; in some cases the patient is pale, with low pulse and diminished heat. Dark sordes accumulate about the teeth; the tongue is at first loaded, red at the tip and edges, and dry;—afterwards, brown and parched;—the urine, at first scanty, dark-coloured, and passed with pain, may afterwards be nearly, or quite, suppressed; soreness on pressure over all the abdominal organs exists; and an offensive odour is exhaled by the surface. This form is sometimes terminated in a few hours by critical sweat. Again, it sometimes ends fatally in a few hours; but it oftener goes on for a few days, a week, or more. It has been observed that the fever is never communicated;—at least it occurs in no instance to attendants, without their passing into it through the previous cold stage.

There has existed, in different places, a varying relative proportion of deaths in the several stages;—as for instance, in India a larger number died in the cold stage, the evacuations having been less under control of remedies than in Europe, and the cases of recovery, without passing through the consecutive fever, were also more numerous. While in Europeans,—from some cause or other, probably from greater strength of constitution, or from the temporary relief afforded by remedial measures,— more survived the cold stage, to swell the list of cases of choleric fever.

The lividity and coldness of the skin, and the peculiarity of the evacuations, have excited much attention

and deserve remark. The blood, changed suddenly in its characters (a subject to be hereafter alluded to at greater length), or thickened by the running off of its liquor sanguinis, no longer finds ready ingress to the capillary circulation,—it cannot in fact freely, if at all, pass through the minute nutritious vessels, the peripheral terminations of arteries and veins, and the portion already in such vessels stagnates, producing the livid colour; neither is it depurated in the lungs for the same reason,—the remora of one portion in the extremely minute capillaries, ramifying on the pulmonary vesicular surfaces, preventing that blood, which should succeed it, from circulating through them as soon, or as fast, as it should. This same condition, the impermeability of the vessels of the lungs, by the the too thick blood, causing a lessened arterialisation in the lungs, must produce a diminution of heat, inasmuch as the latter is disengaged in the general peripheral circulation,—by the combination of the oxygen, conveyed in the arterial blood, with the carbon eliminated from the universal secreting organs,—constituting a virtual combustion.

The discharges from the alimentary canal, known as ricewater evacuations, are ordinarily found to be alkaline;[1] Hermann,[2] however, found them acid, like the vomited matter, in which he detected free acetic

[1] Dr. Parkes (' Op. Cit.,' p. 44), in describing the fluid found after death in the alimentary canal, says, "occasionally there was an alkaline reaction, but this was not constant."

[2] Simon, ' Op. Cit.,' vol. ii., p. 382.

acid; Mr. Goss,[1] also, of the East India Company's service, acted upon the impression of the alvine discharges being acid. They are usually considered to consist of the serum of the blood, and contain flakes[2] or flocculi which resemble boiled paste or rice, and fall to the bottom of the vessel. According to Dr. O'Shaughnessy, neither albumen nor casein is discoverable in these discharges; so that, if this be the case, the evacuations cannot be regarded as composed chiefly of serum; but a decomposition of the blood,—by which the proteine substances have been changed, the albumen being retained in a new form, while the salts and water are discharged,—must be presumed to have taken place. Consistently with the appearance and composition of the evacuations, the blood is found "thick and tarry," "glutinous," "oily," &c., according to the various descriptions given;—but, all agree, it is thick, and will not *flow* from a vein. In it urea has been found in considerable quantity by Dr. O'Shaughnessy; and Dr. Roupell has detected the same ingredient in the bile of Cholera patients.

Prognosis.—Dr. George Budd declares his belief, that in London in 1832, the mortality was *more than* one half the number of the attacks, and that many

[1] Copland, 'Op. Cit.,' p. 126.

[2] Dr. Parkes, 'Op. Cit..' p. 46, says, "Andral states that the effused white substance is not fibrine; or any other constituent of the blood, but merely modified mucus."

cases of other affection were reported and retained, "in order to render the returns less alarming;" this tends to confirm a statement made by Dr. Copland. In the Dovor, a Cholera hospital ship for seamen, the proportion of deaths to cases was as 4 to 7;—93 robust men having been carried off by it out of 160 patients. There is abundant testimony to the fact, that the fatal issue was least resisted by the aged, by women, by infants, and by those weakened by previous or present ailments, or by insufficient, or bad, food. In the decline of life, also, the disease not only met with less resistance to its mortiferous effect, but also to its assault. In the Dovor ship, for instance, the cases that were admitted were taken from one class—a class existing under great uniformity of circumstances in regard to kind of life, and therefore well adapted to furnish evidence of the influence of the mortality exercised by age merely. Dr. George Budd, from whose work this account of prognosis is taken, says, that the effect of age is well shewn by these cases, for, from an examination of the registers kept at the port of London, wherein the ages of all sailors who come there are entered, it will be seen that the proportion of sailors, of the age of forty and upwards, in 5,000 consecutive entries, is 961, or much less than one-fifth;—while of the 160 sailor patients, 57, more that is than one-third, were of the age of forty and upwards. This influence of age, Dr. George Budd remarks, is rendered still more evident, by taking into

the two classes still greater ages. Thus, of the Cholera cases 22 in 160 (one-eighth) were fifty, and upwards; whereas 289 in 5,000, (less than one-seventeenth,) were registered of that age; whereby it is manifest, that the proportion of cases, at and above fifty years of age, was more than double the proportion there would be, if the attacks were equally numerous for all ages. So much for the proportion of attacks; the relative number of deaths is even more influenced by advanced age,—for, of the 22 patients above fifty, in the Dovor, but two recovered, each aged fifty-three; and of 13, above that age, not one survived; while of those between the ages of fifteen and thirty, the deaths were fewer than the recoveries. By the same reports we are informed of the ill influence of previous ailment on the results of the disease. Of 145 cases occurring among ships' crews, supposed to be previously healthy, admitted into the Cholera hospital ship, eighty-two (four in seven) terminated fatally; while of the cases removed from the Dreadnought,—seamen's general hospital ship, and therefore suffering from other illness previous to the invasion of Pestilential Cholera, eleven in fifteen, (nearly three-fourths) died.

An unfavorable prognosis is to be drawn in cases, in which the early symptoms are unusually severe. On the contrary, mild early symptoms indicate a probability of recovery. Collapse is a dangerous combination of adverse symptoms from which few recover,—

loss of pulse at the wrist, great coldness, lividity, and soddenness of the surface, with suppression of urine, being rarely succeeded by reaction and recovery, though not absolutely pronouncing the state irrecoverable. Cramps of unusual severity and continuance have been observed in cases, not accompanied with the most dangerous indications; but a cold clammy perspiration, making its appearance in the cold stage, is always of sad augury,—such being a constant precursor of the fatal event. Additional signs of a mortal isssue pending are presented by an increase of the symptoms of prostration, while the spasms become irregular, clonic, and tremulous, or altogether cease; and the discharges no longer continue. Also, if, with the above, the breathing become stertorous and laborious, with puffing of the lips, inability to articulate or swallow, the worst must be prepared for. In some, too, the evacuations are passed towards the close without the consciousness of the patient,—another fatal sign. In the secondary fever, low delirium, an accumulation of dark sordes, cold surface, low and weak pulse, suppression of urine, restlessness and subsultus tendinum, all point to an unfavorable termination of the attack. Again, in cases succeeded by dysenteric symptoms, a morbid state of alvine evacuations, accompanied by signs of congestion, or inflammation, in the various organs of the abdomen—indicated by soreness on pressure, if continued long without abatement, require strict and attentive treatment; as a

dangerous sequela to the original disease is now presented, though, according to Dr. Copland, it may not end mortally.

A favorable change is announced by returning heat, increasing pulse, the spasms becoming more tonic, the anxiety, heat and oppression at the epigastrium and præcordia being in a great degree allayed; the thirst being less urgent; hiccough supervening; the cadaverous surface gradually yielding to a more natural tint; breathing taking place with greater freedom, and the expired air feeling less raw and cold; a return of evacuation containing bile, and of urinary secretion; with amelioration of the other symptoms of alarm, distress, restlessness, &c. A return of circulating activity,—reaction, may be thus ushered in, and proceed to an established convalescence; or it may unhappily run into the secondary fever already described, and cause the patient to pass through other depths of the disease, scarcely less dangerous than those he had just escaped.

Morbid Anatomy.[1] After collating the detailed descriptions of several authors, that of Dr. George Budd, is here preferred for its elaborate minuteness. But few additions will be made to his account of the appearances found after death.

[1] The valuable details on this branch of the subject, to be found in the excellent work of Dr. Parkes, have been compared with this account, given from Dr. George Budd's article, and it has not been found necessary to make any alteration.

"*Anatomical characters.* In subjects who die in the stage of collapse, the features, after death, are shrunk; the lips, the tips of the nose and ears, the nails of the fingers and toes, are of a leaden hue: the cheeks and upper part of the chest partake somewhat of the same colour, but in a much less degree than during life; and this colour gradually fades after death, while the skin of the entire back becomes of a purple more and more intense, obviously from the blood's gravitating to the latter part. The body and extremities are very rigid, the fingers drawn inwards, the skin of the palms wrinkled.

"The follicles at the base of the tongue are generally enlarged.

"The mucous membrane of the œsophagus is almost always pale and healthy, but now and then presents conspicuous follicles.

"The appearance of the outer, or peritoneal surface of the stomach, and small intestines, varies according to the period at which the disease proves fatal. When death occurs early, or during collapse, the peritoneum is viscid, and the stomach and small intestines are, externally, of a pale rose colour. The viscidity is not observed, or it exists only in a slight degree, and the rose colour is replaced by the ordinary grey tint of the intestines, in those cases that prove fatal after decided reaction. The large intestines are grey externally in every case.

"The stomach is generally large, from the distension

it has undergone. Its mucous membrane, in some cases, whether rapid or protracted, in bloodless subjects, is pale throughout, but commonly offers, either in the splenic or pyloric extremity, or in both, some degree of redness, arising from the injection of very minute vessels on its free surface. These vessels are not arborescent, but appear as short, red dashes, each about a line in length.

"The mucous membrane has rarely undergone any remarkable change in texture, but in most cases it is thickened, and presents a mammellated appearance, either general or confined to the pyloric extremity. In some instances, by drawing the coats of the stomach between the finger and thumb, and using some pressure, a white opaque fluid is squeezed out, and the mammellated appearance effaced, the mucous membrane of the portion so treated being afterwards smooth and of normal thickness and consistence. Sometimes, it offers a few patches of adherent mucus: and we have seen a case, fatal at the end of seven hours, in which there was a coating of viscid adherent mucus over its entire surface. In this case there was the mammellated appearance before spoken of, but it could not be effaced by pressure.

"The mucous membrane of the duodenum is, in some cases, vascular, in others pale; and now and then it has a greyish appearance, as if dusted with a fine black powder. The follicles, or solitary glands, are in all cases very conspicuous, and give the mem-

brane more or less of a granular aspect: they are always most numerous near the pylorus, become gradually less so as we recede from it, and are not observed in the jejunum.

"The coats of the small intestines, when death takes place during collapse, are thickened, and of a doughy feel. The mucous membrane, in some bloodless subjects pale and sodden, generally presents increased vascularity, which occasionally gives rise to patches of a purple colour in the depending portions, especially near the termination of the ileum. It often exhibits the grey appearance that we have already noticed in the duodenum: this greyness, which results from minute black specks at the apices of the villi, is observed especially in cases in which the evacuations during life have contained brown flocculi. We have found it in the entire extent of the small intestine, and, in one instance, confined to the jejunum and upper part of the ileum. The texture of the mucous membrane has rarely undergone any appreciable change.

"The glands of Peyer are remarkably developed in almost all cases, and generally the most so in those that prove fatal early, or in the stage of collapse. They are of the same colour as the surrounding membrane, and, when the latter is pale, are dotted with black points.

"The glands of Brunner may be seen, in almost every case, in the lower portion of the ileum, as small elevated beads, of the same colour as the membrane;

and like the glands of Peyer are generally most marked in those cases that prove fatal in the cold stage."

[In Hope's 'Morbid Anatomy' the appearances of the mucous membrane and glands of the alimentary canal found after malignant Cholera, are delineated (fig. 141), and are also described, as follows, "Exterior of the viscera apparently natural. Stomach healthy! Duodenum as represented in fig. 141, (the specimen being obligingly given to me by Dr. Chambers). Jejunum exhibited few isolated glands at its upper part, but more below; while the ileum was universally studded with them; and also with patches of Peyer, somewhat enlarged. No glands were found in the great intestine; but its mucous membrane was, throughout, *uniformly* congested, pulpy, and very easily separable from the subjacent tissue. (In the other fatal case which was examined, the isolated glands of ascending and transverse colon were universally enlarged, giving the whole interior an appearance of tuberculation). Contents of the bowels were nearly colourless, and had no fæculent or any other peculiar odour."

The history of the case, from which this was taken, is thus given by Dr. Hope:—

"*Case.*—Malignant Cholera at Clapham, nearly three years before the general irruption of the same disease in Great Britain. An old cesspool having been opened, and its contents thrown out immediately contiguous to the play-ground of a boys' school,

twenty-two boys were, within two days, attacked with the disease."

In observing on the case, Dr. Hope makes the following

"*Remarks.*—In the 'Medical Gazette,' March, 1832, I have given the dissections of one child that died, out of thirty-one cases, in the St. Marylebone Infirmary, and also of some others. The identity of the symptoms and *post-mortem* appearances with those of the present case, proves—if other proof were wanting—that the malignant Cholera existed in England before 1832, and was not necessarily an importation from India."]

"The mucous membrane is, in general, more or less coated with the pasty substance, of which the flocculi in the evacuations consist. The other contents of the intestine are like those discharged during life, and require no particular notice: they are devoid of any fæcal odour, and are tinged with bile in those cases only in which reaction has taken place. In some cases in which reaction was transient, we have seen this biliary tint limited to the duodenum and upper part of jejunum.

"The cæcum, and ascending colon are commonly distended, while the descending colon is, in many instances, contracted. The mucous membrane of the large intestine is, in some cases, pale throughout, in others it offers various degrees of redness. It is almost always sprinkled with conspicuous follicles,

which are seen as flat, slightly elevated circles, about a line in diameter, with a central black speck; and which, in every case, diminish in number, and become less conspicuous as we recede from the cæcum.

"The mesenteric glands, which are generally enlarged, are, in some cases, purplish, and, when cut into, give issue to dark liquid blood; in some cases, they are pale.

"The liver presents no unusual appearances: in a few instances, we have observed small ecchymosed spots on its surface, and black fluid blood frequently escapes from the large vessels divided by incision. In all cases that prove fatal during collapse, the gall bladder is found distended with bile of a dark green or olive colour. Many pathologists have noticed, in such cases, a stricture at the mouth of the common duct, preventing the flow of bile into the intestine, when pressure is made on the bladder. Of the existence of such a stricture we have not, however, been able to convince ourselves, and are of opinion that further observation is requisite in order to establish the fact.

"The pancreas presents nothing unusual.

"The spleen is frequently of a light red colour, and, in most cases, of natural size, or smaller than usual, and firm.

"The condition of the lungs varies as the patients die, at a period more or less remote from the attack. When death occurs speedily, or in the cold stage,

they are found healthy, or simply congested; while in a large proportion, according to the observations of Mr. Jackson, who, we believe, first drew the attention of physicians to this circumstance,—in one-half of the cases which terminated fatally after the establishment of decided reaction, one or both lungs present unequivocal traces of pneumonia. We have recently made dissections in eleven fatal cases of malignant Cholera; and found the lungs healthy, or merely congested, in four or five cases that proved fatal within thirty-six hours; while, of the remaining six cases, in which the patients lived at least forty-five hours after the attack, four presented the anatomical characters of pneumonia. In one of these cases, which proved fatal at the end of forty-five hours, the pneumonia was very partial, inter-lobular, and confined to the lower lobe of the right lung; in two, fatal at the end of 96 and 138 hours respectively, the lower lobes of both lungs were in a state of red hepatisation.

"The pneumonia, in such cases, is latent, giving rise to no symptoms, during the life of a patient, which would lead one to suspect its existence. The fact of its frequently existing, made known to us by dissection, is, therefore, of the greatest practical importance, and shows the propriety of investigating, by auscultation, the condition of the lungs, in all cases, in which reaction has been established."

[Dr. Copland, in describing the state of these

organs after death, says, they are "always loaded with black blood, of an oily or ropy consistence, and very closely resembling tar or treacle."]

"The larynx and trachea sometimes contain a frothy fluid, and their lining membrane often presents increased vascularity; but we have never noticed any change in its texture, or any affection of the pleura in subjects who died of this disease.

"The pericardium is sometimes unusually dry and viscid, but much less frequently so, and in a less degree, than the peritoneum. In a few instances, in which the cold stage was very protracted, we have observed ecchymosed spots on the surface of the heart.

"The muscular substance of the *heart* is generally flabby and purplish; the ventricles are often contracted, and the heart, when cut into, presents in a slight degree the appearance which has given rise to the designation, concentric hypertrophy. Fibrinous clots are frequently found in the right ventricle, but seldom, and only in protracted cases, in the left; and never in these, unless they exist also in the right. In other cases, in those chiefly that prove fatal during collapse, the ventricles contain dark, fluid, or grumous blood.

"In the veins, and in the arteries, even in the aorta, the blood is also dark, and fluid or grumous; but like that in the ventricles, it imparts no stain to their lining membrane.

"The kidneys are natural in size and texture. In

most cases, the cortical substance is purplish throughout, or pale, but offering dark, congested vessels; and from the mammillary points, a whitish fluid, having somewhat the appearance of pus, can be squeezed out.

"The urinary bladder contains only viscid mucus, and is shrunk under the pubis and contracted, in subjects who die during collapse; but we find in it a small quantity of urine in some of the others.

"In the organs of the nervous system, there is no trace of disease except a certain degree of congestion in the brain and its membranes, which is met with in some cases."

CHAPTER III.

NATURE OF PESTILENTIAL CHOLERA.

In the last chapter we have given some of our reasons for dissenting from the authority of Dr. Copland as to the presumed newness of this Pestilence. We shall but briefly revert to it, contenting ourselves with placing before the reader the diagnostic distinctions between this disease and the more common Cholera of India or other countries. Under the head of Diagnostic Characters[1] in the work of Dr. Copland we read,—"In sporadic or bilious Cholera, the very dark, thick, and ropy appearance of the blood; the cold, wet, and shrivelled state of the surface; and its leaden, dark, or purplish colour; the almost total absence of pulse at the wrist; the very marked and rapidly increasing collapse of the powers of life; the disagreeable and earthy odour of the body, even during the life of the patient; the burning sensation between the scrobiculus cordis and umbilicus; the complete arrest of the glandular secretions; the cold tongue and mouth; and the coldness of the respired

[1] Copland, 'Op. Cit.,' Art. Chol. Pest., par. 49, 50.

air, which characterize the pestilential disease, are entirely absent.

" In one, the powers of life are certainly very much deranged, and the circulation and functions of the internal organs greatly disturbed; but in the other, all the derangements and their attendant symptoms are of a much more alarming and malignant nature; the balance of the circulation is much more completely overturned, the circulating fluid itself much more sensibly and seriously diseased; the respiratory functions infinitely more disturbed; the spasms of the voluntary muscles more general, and more clonic as respects their nature; the purging and vomiting slighter and of shorter duration, and forming a less prominent feature of disease; the surface of the body more deprived of its vitality, of a much darker colour, and more collapsed and shrunk; and the powers of life are more completely overwhelmed, and sooner sink altogether, than in the severest forms of Cholera observed to occur occasionally in warm climates, or in temperate countries, under circumstances favorable to their appearance."

Here, it will be observed, the main diagnosticating distinctions insisted on are, by the author's language, admitted to be in gradation chiefly. Thus, in Pestilential Cholera, " all the derangements and their attendant symptoms are of a *much more* alarming and malignant nature;" " the balance of the circulation is *much more* completely overturned;" " the circu-

lating fluid itself *much more sensibly and seriously* diseased;" "the respiratory functions *infinitely more* disturbed;" "the spasms," &c., &c. The above passages, with the words in italics, are taken to show, that the statement here made fails to prove more, than that an aggravated form of disease exists in Pestilential Cholera; and, without its being here affirmed, that the latter is not a new disease, it may safely be declared not proved to be so.

Dr. George Budd also infers that "malignant Cholera is essentially different from sporadic;" and that it is so in one, and that the principal feature of Pestilential Cholera, is obvious enough;—one is limited, the other almost universal in its diffusion. But there has been, and in this country, abundant opportunity of observing Cholera in other than its sporadic form, even before 1831 and 1832. The sporadic character having in Sydenham's time given place to an epidemic form of the disorder. We have already quoted the statement of Sydenham, in regard to Cholera, who says, that this disease was more epidemic in the year 1669, than he ever remembered to have known it in any other. As to the differences to be found in severity of symptoms during life, or in the appearances of the evacuations and blood, either in life, or after death, what has been remarked before as to gradation forming the main distinction,—if applicable at all,—will apply here with equal force.

Dr. Hope comparing the cases of sporadic 'Malig-

nant Cholera,' at the Clapham school, with those occurring in the Epidemic disease of 1832, makes the following remark, which is pertinent to our present discussion. "My friend Dr. P. M. Lathan, (who, with Dr. Chambers and Mr. Pearson, was in attendance,) on seeing thirty children affected with the epidemic Cholera, in February, 1832, under my care at the St. Marylebone Infirmary, stated that, 'from the identity of the symptoms, he could have imagined himself to be again in the midst of the scene at the boys' school.'"

To the question asked by Dr. George Budd,[1] "Is malignant Cholera essentially different from sporadic?" we answer, by warrant of the foregoing statements, that the proof of such *essential difference* is not only insufficient,—a conclusion by which we are compelled to dissent from that gentleman's opinion,—but that there is ground for an opposite inference.[2]

To another question asked in the same page "Was malignant Cholera known to the ancients?" some reply must now be attempted;—this from deficiency of definite accounts is less easy to deal with, our conclusions therefore must be merely inferential. We believe that in India it had prevailed so early as 1774. And it may be not unreasonably concluded, that, as we have reports of the existence of this

[1] 'Op. Cit.,' vol. iv., p. 117. [2] Parkes, 'Op. Cit.,' p. 46, note.

disorder as far back as they could be well supplied, the disease may have frequently occurred before that time. In Hecker's 'Epidemics of the Middle Ages' is given a very early history of convulsive changes in the earth's surface in China and the East in general, followed by famine and pestilence. It is said that a Plague (a pestilence) arose in Tche which carried off 5,000,000 people, (p. 12.) and it is as likely that this pestilence was that of Cholera, as that of Plague. This author (Hecker), in the same chapter of his work, testifies to the existence of two forms of this last named pestilence (the Plague); at page 21, he says, "a milder and a more malignant form certainly existed, and the former was not always derived from the latter, as is to be supposed from this circumstance—that the spitting of blood, the infallible diagnostic of the latter, on the first breaking out of the Plague, is not similarly mentioned in all the reports; and it is therefore probable, that the milder form belonged to *the Native Plague*,—the more malignant *to that introduced by contagion.*"

Dr. George Budd infers from the difference in the character of the evacuations (so uniform in their appearances in Pestilential Cholera), in the disease as described by old authors (Aretæus and Celsus), that, had they been called to treat malignant Cholera, some notice of these characteristics of the evacuations in Pestilential Cholera would certainly have been left to us.

Another accomplished writer, in allusion to the general subject of Contagious Diseases, called Pestilences, makes the following remark,[1] "after a pretty extensive investigation into the histories of pestilential epidemics, we have come to the conclusion, that the Plague has almost invariably assumed one or other of the following phases :—

"1st,—That of Cholera and Dysentery. The Plague described by Thucydides, and that of Ingrassias, and many other pestilential epidemics, described in ancient and modern times, including the Asiatic Cholera of the present age, belong to this class.

"2nd,—That of profuse, and, as they have been termed, Syncoptic Sweats. The celebrated epidemic of the fifteenth century, now so admirably illustrated by M. Hecker, is the best marked instance which we possess of this form of the disease. M. Hecker, indeed, supposes that the cardiac disease of the ancients was of a similar nature to the sweating sickness. But it strikes us (although we must admit that we have not had time to consider this point maturely), that the syncoptic fever or cardiac disease of the ancients, was not of a pestilential nature.

"3rd,—The other form is the Glandular Plague, which many late authorities would consider as the only form of the disease ; but, as we think, erroneously, since the other types are often mixed up with

1 'Paul. Æginet.,' by Mr. Adams (Syd. Soc.), vol. i., p. 287.

this in the same epidemic. Thus in the Plague of Aleppo, during the years 1760, 1761, and 1762, although the ordinary form of the disease was the glandular, a considerable proportion of the cases assumed the first form which we have noticed. And in the Plague of Athens, although it commonly put on the appearance of the first form, it would appear probable, from the obscure allusion to cutaneous eruptions in the description of Thucydides, that a certain proportion of the cases were of the second type. The three forms then would appear to us to be as closely allied to one another as diphtherite, ulcerous sore-throat, and scarlatina are; that is to say, that they are all varieties of one species of disease." Further, Sydenham treated of Epidemics of plague and pestilential fever, which occurred about the same time, in one chapter, and gives as his reason,—that there was good ground for considering them as modifications of one and the same disease.

In Dr. Holland's 'Notes and Reflections,' an apparent effort is made to generalize certain epidemic disorders, with a view to devise some general principles for our guidance in the contemplation of epidemics.

A similar attempt, though in a somewhat different direction, has been made by Dr. Billing, who though he affirms not, that Pestilential Cholera is Ague, says,[1] "When, however, I encountered the enemy hand to

[1] 'Principles of Medicine,' p. 242.

hand, I saw at once that it was *like* Ague." Dr. Billing also states, that treatment successful in Ague was so too in Pestilential Cholera.

Though not supplied from the literature of the ancients with clear and distinct descriptions of these diseases, we have no better reasons for concluding that Pestilential Cholera,—or, at least, Cholera,—was unknown in the category of their Pestilences, than we have to conclude that small pox, or fever, was unknown. We repeat, that the mere supervention of extensive prevalence, with aggravated symptoms, is no more proof of newness in a disease, than the appearance of the full array of symptoms of scarlatina might be, if they should occur in a locality where, previously, diphtherite, or malignant sore throat, had alone been familiar to the inhabitants. We believe, therefore, that Pestilential Cholera *is not a new* disease, and that, in some of its modified forms, *it was most probably known* to the ancients.

When we come to the consideration of the causes of Pestilential Cholera, contained in the second part of this work, abundant reason will be supplied, whereby to support this line of argument. Suffice it, here, to say, that it is contrary to all analogy to deduce from the known facts, that any new element of disease, or materies morbi, started into being at Jessore in 1817; nor is it needful to conclude, that some old morbific element, or agent, was then, for the first time, so modified by transmission through the human body,

as to become capable of producing a disease marked by a train of symptoms not previously witnessed. Is it not enough to follow out to its conclusions, Dr. Copland's statement about the non-communicability of small pox on the coast of Africa, while certain atmospheric conditions prevail, to induce the belief of the possibility, at least, of a disease so much less communicable than small pox, as Cholera undoubtedly is, under ordinary circumstances, becoming with changes favorable to its transmission, extensively prevalent? Or, as with Plague, can it be unreasonable to infer, that a disease endemic in India, and other Eastern Climes, shall be fomented by peculiar causes into a violent and malignant Pestilence?—The same agency, which imparts to the distemper its virulence, robbing its victims of their power to resist its attack.

CHAPTER IV.

THE CAUSE OF PESTILENTIAL CHOLERA.

We shall in this chapter attempt to give a brief, but clear, view of the existing state of the dispute on on this head. The opinion and arguments of Dr. George Budd, a decided non-contagionist, will be given, as a fair illustration of the state of opinion of the party, he may be supposed to represent; and, on the other side, the opinion and proofs of contagiousness, supplied in the article by Dr. Copland, will be sufficient to show how far, up to the present time, his party are able to sustain their argument. For but little more than this can we find space within the limits, we have prescribed for ourselves. We shall, however, endeavour to test the validity of the arguments on both sides, by reference to the following rules, which most readers will consider sufficient for the purpose.

If the Pestilential Cholera is infectious, it ought,

1st,—To diffuse itself by the various channels of communication from its first focus or foci, which, in an early period of the disease, might generally be traced; this must take place no more rapidly, than is

compatible with the degree of human intercourse. This rule may however be even confirmed by its *apparent* breach; as when—

2nd,—The disease suddenly makes its appearance in places, remote from its original focus, but coincidently with the arrival of infected persons into towns, or of infected vessels into ports. Coincidence, it is true, is no proof of co-operation; but should the Pestilence break out in several remote places, simultaneously holding communication with an infected place, we should by the doctrine of chances be pressed to conclude, that such was not the result of mere accident.

3rd,—When the pestilence is prevailing in a district, certain places, either from being in a thinly peopled part of it, or from holding no communication with infected localities, altogether escape infection, or after a period of exemption, on some accidental, though accountable, introduction of the disease from without, it rapidly extends its ravages among the previously healthy.

4th,—In an infectious disease the friends and attendants,—the medical men and nurses—are, from their greater exposure to the exciting cause, expected to sicken of it in a proportion greater than the general average.

Dr. George Budd,[1] after pointing out the supposed weaknesses of the arguments for contagion, adds—

[1] 'Op. Cit.,' v. iv., p. 107.

"We proceed to offer the reasons which have convinced us that the disease is not propagated in this manner.

"1st,—The medical men and attendants on the sick have not generally been attacked in undue proportion; now as these persons are exposed in a degree incomparably greater than those who never approach the sick, they could not fail, if contagion existed, of suffering in a corresponding proportion. We have said that they did not generally suffer. Such was the case in India and in this country; and very striking instances of their exemption may be adduced. When the disease appeared in London in 1832—H. M. S. Dovor was fitted up as a Cholera hospital for seamen, and stationed in the river, where the disease was most prevalent: more than two hundred sailors, affected with it, were admitted there: three nurses and one of the medical men lived on board: the other medical men, four in number, were in daily attendance: yet, of these persons, medical men and nurses, not one was attacked, although the former were engaged, almost daily, in examining the bodies of those who died of the disease, and that in the lowest part of the ship, in an ill-ventilated cabin, in which all the dead bodies were placed. When the disease again showed itself in the metropolis in 1834, the medical men and nurses of the hospital ship Echo, which was appropriated to the same purpose, enjoyed a like immunity: and in fact, from the first appear-

ance of malignant Cholera in this country to the present time, not one of the medical attendants of the Dreadnought, the hospital for seamen in the port of London, or of the Cholera hospitals connected with it, have taken the disease.

"A striking example of the same kind, noticed in Edinburg, is given by the late Dr. Mackintosh; he says, 'In the Drummond Street Cholera hospital,' (of which he was physician) 'there were two hundred and eighty bodies examined. Two and sometimes three hours were spent in examining each body. The room where these examinations were conducted was a miserable place, eight feet square; generally six or eight persons were present, sometimes more; and, in an inner apartment, about ten feet square, there generally lay six dead bodies. Not one of those who frequented this den of death, and who had their hands imbrued in the secretions of the dead for six hours out of the twenty-four, were affected with Cholera, although their hands were irritated and punctured daily.' ('Practice of Physic,' p. 345.) A great number of instances of a like kind might be adduced, but the argument does not rest on particular examples, but on the fact that the attendants on the sick were not *generally* attacked in undue proportion, regard being had to the circumstances in which they were placed. Where Cholera prevailed, as it most commonly did, in particular parts of a town, the medical men, who attended the sick in these infected

parts, were of course exposed to those local influences which were the cause of Cholera in their inhabitants, and suffered therefore in a greater proportion than the entire population.

" The example of greatest mortality among medical men and nurses occurred during the prevalence of the disease at St. Petersburg; but it appears, from the report of Drs. Russell and Barry, 'that in some Cholera hospitals, favorably situated, with respect to site, ventilation, and space, very few of the attendants suffered.'

"'In the hospital of the Semanofsky Guards, not far from the barracks, out of forty attendants on Cholera patients, six were attacked, and two died, between the mornings of the 11th and 13th.' 'In the military general hospital, into which upwards of four hundred Cholera patients had been admitted, from distant quarters, up to the morning of the 13th, only one attendant had been attacked.'

" 2nd,—The disease has not been disseminated, as contagious diseases usually are, under circumstances of free intercourse: in this country it did not spread into agricultural districts, but was confined to towns, and generally to particular parts of towns. In the spring of 1832, we witnessed the epidemic of Cholera at Ely, which is built on a hill, rising out of the fenny district of Cambridgeshire: the disease was confined to the low and dirty streets at the foot of the hill; no cases occurred in the high and clean parts of the

town; and, during the summer of the same year, we observed the epidemic at Plymouth, where Cholera prevailed to a great extent; there also the parts of the town inhabited by the wealthier classes were almost exempt from the disease; and, although continual intercourse with the country people was kept up, it did not spread to the rural villages adjacent. The history of Cholera abounds in instances of the same kind: we shall only mention one more, which is given by Dr. Albers, in his report of Cholera at Moscow. He says, 'during the epidemic, it is certain that about 40,000 inhabitants quitted Moscow, of whom a large proportion never performed quarantine; notwithstanding this fact, no case is on record of Cholera having been transferred from Moscow to other places; and it is equally certain, that in no situation appropriated for quarantine has any case of Cholera occurred.'

"But here, as in the former case, the argument is not grounded on particular instances, however striking, but on the fact, that the disease has not been disseminated *generally*, in the manner of contagious diseases.

"3rd,—Another argument against the contagious nature of malignant Cholera, is, that quarantine regulations have totally failed to prevent its advance. There are many instances of its having broken out in a place after the enforcement of the strictest quarantine for fourteen or twenty-one days, or even longer; so that the opinion, that it is contagious,

can be maintained only by the supposition, that it has occasionally a long period of incubation; a supposition which is opposed by the fact, that, in cases where the time, intervening between first exposure to infection, and the development of the disease, has been most accurately marked, the period of incubation has ranged from one to five days.

"'The subsidary force under Colonel Adams, which arrived, in perfect health, in the neighbourhood of a village in India infected with Cholera, had seventy cases of the disease the night of its arrival, and twenty deaths the next day.' (Bengal Report, pp. 22, 23.)

"'Her Majesty's 54th regiment landed at Madras on the 10th of May, in a remarkably healthy state, after a voyage of forty-eight days, from the Cape of Good Hope, and marched into quarters at Fort St. George. Cholera appeared among the men within three days after their landing.' (Madras Report, p. 23.)

"4th,—But the strongest argument against the opinion that Cholera admits a long period of incubation, or that it is contagious, is afforded by the shortness of the duration of certain epidemics. In 1834, the duration of the epidemic in London was less than six weeks; and, in many instances, the disease has ceased in a town within a month, or even three weeks, after its first appearance there. Instances of this kind could scarcely happen if it were con-

tagious, or admitted a long period of incubation. But it is not only in particular towns, and in districts of small extent, that the prevalence of this disease has been of short continuance. Throughout England, and great part of Europe and America, it ceased entirely, and of itself, within two years of its first appearing in these countries. A parallel instance cannot, we believe, be found in the history of any other disease, capable of being communicated by contagion, and we consider this circumstance alone almost decisive that malignant Cholera is not propagated in this manner.

" Most of the arguments against contagion, here advanced, were illustrated by the partial epidemic of malignant Cholera in London, in the autumn of 1837. During the summer of that year it had raged in Italy, and gradually advanced towards us, appearing in succession at Naples, Rome, Berlin. On the 8th of October, a patient in the seaman's hospital, the Dreadnought, was seized with Cholera, and between that time and the 28th, twenty cases occurred there, of which twelve proved fatal. None of the nurses or medical officers of the Dreadnought were attacked, although the latter lived on board, were in constant attendance on these patients, and, in all the fatal cases, spent a considerable time in examining their bodies, in a small cabin appropriated to their reception. The persons attacked with Cholera, were admitted into the Dreadnought for other complaints:

not a case occurred in any other vessel in the Thames; and although during the prevalence of the disease, patients were discharged almost daily from the Dreadnought, who immediately entered other vessels, they did not, in a single instance, communicate Cholera to their crews. The person in whom the disease first showed itself, left Dantzic for this country on the 8th of September; no case of Cholera occurred in the vessel in which he sailed; so that the disease, if introduced by him, must have had a period of incubation of at least thirty days, a circumstance extremely improbable, if we consider that the second and third cases occurred within forty-eight hours of the first; that five patients, seized on the 21st and 22nd of October, had come from the four quarters of the globe, and consequently could not have brought the disease, and, at the time of their attack, had been in the hospital from two to seven days only; and that the whole duration of the epidemic was only nineteen days. This last circumstance we conceive to be of great force; it shows that of all the cases, after the first, not one presented a period of incubation at all equal to that which, to maintain the supposition that it was brought from abroad, we must admit for the first; and, as no measures of seclusion were taken with respect to these patients, it is scarcely explicable on the hypothesis that the disease is communicated by contagion.

"But what tends still further to show, that in this

instance the disease was not introduced by contagion, is, that while Cholera existed in this isolated manner in the Dreadnought, and when other parts of London were free from it, some cases occurred in the Marylebone Infirmary, situated in a part of the metropolis the most remote from, and maintaining the least intercourse with, Greenwich, where the Dreadnought is stationed.

"The reasons given above are, we imagine, sufficient to show that malignant Cholera is not propagated by contagion: and the fact that it has prevailed in so many countries, and among people so different in every circumstance of social life, proves that it did not depend on food, or on any circumstances or habits which serve to distinguish particular countries or people.

"The facts noticed in a preceding part of this paper, in our recapitulation of the progress of Cholera, prevent us from ascribing the disease to any atmospheric circumstances that we can appreciate, such as temperature, moisture, direction of winds, electric condition; and the isolated manner in which it has, in many instances existed (as in the Dreadnought, in 1837, when it prevailed in that ship, and in no other vessel in the river), does not allow us to ascribe it, solely, to any general atmospheric influence whatever: while the wideness of its diffusion at other times (as in 1832, when it raged at once in a considerable part of Asia, Europe, and America), prevents

us from ascribing it *exclusively* to the agency of local causes, such as miasmata, filth, defective ventilation, a crowded population; such causes having, moreover, been in action for ages without giving rise to any disease resembling Cholera. We can account for the phenomena only on the supposition of some peculiar atmospheric condition, capable of unlimited gradual diffusion, but rendered more active by the local circumstances that have been found most conducive to the disease."

We will not stop here to comment upon this argumentation of Dr. George Budd, but at once proceed to lay before the reader an abstract of the proofs of contagion advanced by Dr. Copland. In doing this, we shall arrange the statements in the numerical order of the four rules given above; which we can do, as we shall be obliged to select and condense—to compress into as short a space as possible—the elaborate and minutely detailed supports of the argument; whereas we preferred to give Dr. George Budd's in its entire form, as it was sufficiently concise for our limited space. It may, moreover, facilitate the formation of a judgment on this litigated question, if we proceed in the following manner,—first, to give the rule, then the accordant facts supplied by Dr. Copland, and, with these to contrast the foregoing statements or reasons of Dr. George Budd.

1st,—Pestilential Cholera, if infectious, should diffuse itself by the various channels of commu-

nication from its first focus or foci, which in an early period of the disease, might generally be traced; this must take place no more rapidly, than is compatible with the degree of human intercourse.

"The members of the Medical Board of Bombay, in the preface to the reports sent to them, and published at Bombay in 1819, state, that the disease had extended from Poonah to Panwell, a considerable village in the main line of communication between Poonah and Bombay; that a man, who had left Panwell and arrived at Bombay, a distance of about fifteen miles, was soon afterwards attacked by the disease, and communicated it to those attending him; that it was traced in parts adjoining Bombay, and on the island, from village to village, by the arrival of persons affected with it, from places where it was known to prevail; and that there were places which, from want of this sort of communication, had, up to the time of the report, entirely escaped. From the foregoing and other data, the members of the Bombay Board—the first to furnish information respecting the disease—conclude that—'It appears to them incontrovertible, that this disease is capable of being transported from one place to another, as in cases of ordinary contagion or infection, and also to possess the power of propagating itself by the same means that acknowledged contagions do, that is, by the acquisition of fresh materials with which to assimilate.' (Bombay Reports, &c., pp. 10, 11.) In the same

reports we find Captain Sykes stating, that he ascertained that the disease did not break out in any village 'until that village had communicated with a neighbouring place in which the disease existed;' and he furnishes several instances proving this fact. Besides, he states, that the attendants on those first seized in his company were attacked, and that it spread from one of his servants to five, whilst the gentlemen in the next tent had not one affected; and, he remarks, that he could add similar instances to those now adduced. (Op. Cit., p. 118.)

" Mr. Coats, surgeon, in a letter to the President of the Bombay Medical Board, states, that the idea most prevalent was, that the disease was brought from Jaulna to Aurungabad, and that its progress could be traced distinctly through the villages on the chief road from Nagpore to those places (p. 145). He afterwards states, that the information as to the extension of the disease by infection was not only furnished by Europeans, but that some Brahmins had given similar information, without any particular enquiry on the subject having been made of them. From these and other facts, he concludes by considering the disease infectious; and that, 'if it was occasioned merely by a distempered state of the air, it would have spread over the country with some regularity, but the epidemic seems generally to have travelled in lines along the post roads, and always to have required succession of objects for its propa-

gation. In Candeish, where there is not sufficient population, and but little intercourse between the villages, its progress was slow. At Pundergoor it made its appearance at the time of the great Jatra, and was spread at once in all directions by the pilgrims returning to their homes." (Op. Cit. pp. 150, 151.)

"Dr. Jukes states, that the disease travelled along the high road from the Deckan to Panwell, and that he has not heard of any village in the Conkan that has had the disease, but by intercourse with places in which it had been already prevalent. "If it be something general in the atmosphere," he remarks, "why has it not hitherto made its appearance in some two distant places of the province at the same time? Nothing of this kind has, I believe, been observed: it still seems to be creeping from village to village, rages for a few days, and then begins to decline." (p. 173.)

Mr. Jameson, the editor of the report on Cholera from the presidency of Bengal, reasons against the infectious nature of the disease, but, towards the conclusion of his report, expresses himself in the following manner;—"This much, however, may be affirmed, from a review of the whole progress of the epidemic in this quarter, that the infectious medium, in whatever it consisted, was confined within a very circumscribed circle, and was very slowly extended to healthy parts of the atmosphere. If, setting aside the circumstances militating against it, we take it for

granted that the infection was truly received by the centre and Hansi divisions from the detachments above mentioned, we must believe that the disorder, although not communicable from person to person, was so from one large body to another large body; and that whenever the poison got head amongst a number of men, it assumed some new quality, so as, when mixed with the atmosphere, to become infectious. What constituted this additional quality, we cannot pretend to determine; but in support of its existence, we may quote the predilection of the epidemic for cities and camps; the infection of the left division, and the Nagpore and Meerut troops, immediately after entering into the diseased medium at Jubbulpore, Nagpore, and Delhi; and the similar case of the troops and followers, in attendance upon the governor-general, being attacked shortly after communicating with an infected village in the Gorruckpore district. To the same account may be placed the progressive march of the disorder from one part of an infected place to another, as in the centre and Hansi divisions, and more particularly the Rajpootana force, in which the virus seemed to be regularly propagated from corps to corps. In some instances the suffering body would appear to have sickened immediately upon coming into the poisonous medium, as was the case with the Nagpore troops, who were affected on the very day in which they encamped at the infected village of Gaongong; but

more frequently one or two days would seem to have been requisite to bring the virus into action. Thus the Meerut detachment entered Delhi on the 29th, and was not affected till the 31st; thus too the Hansi troops had not the disease till the 6th, the day after the junction of that detachment. Again, by those abetting the opinion of the disorder being communicated to the centre division by the Shergur detachment, it is stated, that the first cases occurred on the 11th, two days after its junction. Lastly, the followers of the troops in personal attendance on the governor-general in April first suffered on the 23rd, three days after encamping near the infected village." (pp. 144—146.)

Mr. Scott, the editor of the reports which were transmitted to the Madras Medical Board, writes, " Bodies of troops in motion have been attacked, and have retained the disease, while it was unknown to the fixed inhabitants of the country through which they passed. One of two corps in a camp has been attacked, and the other has escaped the disease. Ships arriving from other parts of the world have never suffered under the assumed epidemic constitution of the atmosphere before reaching the shore." " Diseases avowedly infectious, such as small pox, measles, &c., have not at all times the power of spreading epidemically: for while it is certain that their exciting causes are never wholly extinct, it is only at particular periods that these diseases become epidemic; but we

are unacquainted with the circumstances under which this power of epidemic propagation arises. The same may be the case with Cholera. All the atmospheric phenomena, and other circumstances brought under the head of occasional causes, have, with little or no interruption, existed from the beginning of time until now, without producing Cholera—consequently the super-addition of a new cause must be inferred. An European, proceeding on his journey to Trichinopoly, on the 15th October, was taken ill about a mile from the mount, and brought back to the house, where he had passed the day, and there died. On the 17th the wife of that person, on the 19th the owner of the house, and on the 21st his wife, all experienced attacks of Cholera, but recovered. Several of the native servants also suffered." After detailing some remarkable instances of the disease being communicated by marching troops to the inhabitants of places where they halted, and sometimes to other healthy troops, as at Gooty,—to be presently referred to,—he proceeds, " It also spread on that occasion to the adjacent villages. It also appeared in a detachment of artillery, previously perfectly healthy, upon their encamping on the ground which had been immediately before vacated by the 1st battalion of the 8th regiment, in which corps the disease prevailed. The bodies of several persons, who had died of Cholera, remained exposed on the ground, when it was taken up by the artillery. The prisoners

in a gaol, enclosed by a high wall, have escaped Cholera, while it prevailed all around them; and the inhabitants of certain hilly ranges have also escaped the disease. These have been said to have interdicted all intercourse with the people below. When Cholera is once established in a marching regiment, it continues its course in spite of change of position, food, or other circumstances. Its approach to a town has been traced from village to village, and its first appearance in a town has been in that quarter which was nearest the track of its progress. The sudden appearance and disappearance of Cholera, however unlike the progress of known infectious diseases, is not admitted as being irreconcileable with the doctrine of infection, especially if the disease be of sudden invasion after the application of the exciting cause. The relations, who have attended on people ill of Cholera, as well as the nurses appointed in military corps for that duty, and in general those whose employment has led them to be much with the sick, have been observed, in very many instances, to be attacked with Cholera during, or shortly after, their attendance. The sick in hospitals, labouring under other diseases, have likewise been observed to be attacked with Cholera, especially those who lay near the patients ill with that disease. Sometimes whole families have been swept off successively. Servants have often been observed to sicken after attending their masters." (Madras Reports, p. 48, et seq.)

Dr. Reimann, of St. Petersburg, has supplied the following statement in reference to the extension of Cholera throughout Russia:—"The Cholera was brought to Astracan by ships, and it has spread itself over Russia from Astracan by the emigration of the inhabitants, principally those of the lower orders. This is the chief cause of its propagation in Russia; it has never shown itself in any place, except where it has been brought by travellers, who came from infected places. *We have not a single instance* of a town or of a village, which, without communication with houses or persons affected, has contracted the disorder. Several places surrounded by the disease have preserved themselves from it by a rigid insulation."

Drs. Barry and Russell, sent by the British government to investigate the phenomena of the disease in Russia, report, that "the Navarino Corvette, Captain Nachinoff, 200 men, had been placed two miles to the eastward of Cronstadt during the epidemic, to question and examine all craft from St. Petersburg. She had eleven severe cases of Cholera, of whom eight died. Her first and second cases occurred on the 26th of June, O. S. These two men belonged to the boat that examined the vessels coming from St. Petersburg, on board many of which they had been. The next men who fell ill were of those, who carried the two first cases to the hospital in town."

We shall conclude our selection of the proofs supplied by Dr. Copland, which we can refer to the

1st rule, with one which may be referred to either the first or second rule, having an intermediate or connecting character. This instance occurred to Dr. Copland personally, he says;—"Soon after the opening of the first Cholera Hospital in the vicinity of London, near Bermondsey, I passed a considerable time with the patients admitted, and was present during the inspection of two fatal cases. I drove thence in an open carriage and saw two relatives, residing in an airy situation in Pentonville, a distance of from three to four miles; and yet the persons whom I visited, after so long a drive in the open air, complained to me instantly upon my entering their apartment of the offensive odour which proceeded from my clothes. I was cautious in not mentioning the source of this odour, and no suspicion was entertained by them of the cause. But the following day I was called to them, and found them both in an early stage of the distemper, from which they ultimately recovered with difficulty. Precautions were taken against the further extension of the malady in this house, and no case occurred in the vicinity until some months afterwards."

The objections urged by Dr. George Budd against the sufficiency of the proofs accordant with our first rule, are mixed with those which will oppose the second also; it will, perhaps, therefore, be best to to defer the contrast of these with the statements, just quoted from the writings of Dr. Copland, until

we have collected the testimony found applicable, according to the second rule; viz.,

2nd,—The disease suddenly makes its appearance in places, remote from its original focus, but coincidently with the arrival of infected persons into towns, or of infected vessels into ports.

"The instances of the disease appearing at places immediately after the arrival of corps and detachments, which were suffering from it, are very numerous. For example, it appeared at Aurungabad, and at Malligaum in Kandeish, after the arrival of parties, who had left Jaulnah at the time the disease was prevalent there, and amongst whom it had broken out on the march to these places. It appeared a second time at Malligaum, after the junction of the 1st battalion of the 5th regiment, in which Cholera prevailed. It appeared at Secundrabad after the arrival of a detachment suffering from it, and it appeared afterwards in the villages through which the detachment moved. It appeared at Gooty, where no case had been observed for six months before, immediately after the arrival of the 1st battalion of the 16th regiment of foot, in which it prevailed with great mortality. It is remarkable that the same formidable type of the disease which prevailed in the marching corps was communicated to the corps at Gooty." "Superintending Surgeon Duncan states, that the 34th regiment carried the pestilence with them from Bellary to Nundydroog, and there was no trace of the

disease in any village on the road. Since the regiment passed, every village on the road has been attacked by the Cholera.' " (Madras Report, p. 111.) " Several authors have insisted on the proofs, which have been furnished of the introduction of the disease into the Isle of France by the Topaze Frigate, and the circumstance of about 20,000 of the inhabitants having been seized with it, above two-thirds of whom died, no precautionary measure having been resorted to; but that when the malady had been propagated to the adjoining island of Bourbon, a sanitary cordon was established, and only 256 persons were attacked." " According to the reports of the Medical Board of Ceylon, the disease made its appearance in 1819, in Jaffnah, in Ceylon, imported from Palamcottah, with which Jaffnah holds constant intercourse, and thence it was propagated over the island. In August 1820, the Leander is stated to have called at Trinquamalee from Pondicherry, and to have landed several of her crew affected with Cholera. Trinquamalee soon afterwards was infected, and the Pestilence was again propagated over the island. The island of Sumatra was believed to have been infected in 1819, from the intercourse carried on between Achem and Malacca, across the intervening strait; and it seems to have reached Penary and Singapore towards the end of the same year, in the same manner."

" M. Moreau de Jonnes states, that it was imported

into Muscat in Arabia, by the English East India ships; and Dr. Salinas says that it was carried into the port of Bassorah in 1821, by a vessel from India; and that it spread from this port, extending from town to town, even as far as the coast of Syria. When the Pestilence reached Manilla in 1820, where it was believed to have been imported by ships, whose crews had been, or were, infected, those vessels in the harbour, which abstained from intercourse with the shore, entirely escaped. At Bankok, the capital of Siam, it was said to have been introduced by the ships trading there from British India. It was supposed that 40,000 persons were attacked in this city and vicinity. Its appearance in Java in 1821, was likewise considered to have been owing to the unrestricted intercourse of infected vessels, particularly the junks trading to Samarang, whence the Pestilence spread over the island, carrying off upwards of 100,000 of its inhabitants. Its irruption in Canton, in 1820,—in Macao, in 1823,—in the Moluccas in the same year,—and in various places in the Persian Gulf, and on the coast of the Arabian peninsula, was generally attributed to vessels which had arrived from infected places."

The following, communicated by Dr. Russell ('Medical Gazette,' Nov. 11th, 1831), is to the same purpose:—"The son of a villager in the government of Pensa, who was coachman to a nobleman at fifty versts distance, died of Cholera; the

father went to the place to collect the effects of the son, and brought home with him his clothes, which he put on and wore a day or two after his arrival at his native village. He was shortly thereafter seized with Cholera, and died of it: three women, who had watched him in sickness and washed his body after death, were also seized, and died of the disease."

Concerning evidence of the nature of that adduced under these two rules, Dr. George Budd speaks as follows:[1]—"The foregoing reasons, although we are quite ready to admit that they have considerable force, are far from being decisive of the question. Any influence, any combination, for example, of atmospheric circumstances, might, and probably would, be progressive. Influenza, which no one, we believe, supposes to be contagious, and which on more than one occasion has almost rivalled Cholera in extent of diffusion, was also progressive, although its progress was much more rapid than that of the latter disease.

"With respect to the circumstance, that Cholera has appeared to follow the lines of human intercourse, it may be asked, did not this result from its having attracted more notice on these lines, from their being more open to observation, and from the fact that they generally connect large and populous towns, where the disease has made the greatest havoc, and where, for various reasons, its greatest effects have been most observed?"

1 'Op. Cit.,' vol. iv., p. 106.

"Granting the fact of its progression, the extensive relations and increasing activity of modern commerce must render the coincidence of its appearance in a port soon after the arrival there of a vessel from one previously infected, a circumstauce of frequent occurrence."

Under the second head of Dr. George Budd's argument against the contagiousness of the disease, the reader will remember that he states, that "the disease has not been disseminated, as contagious diseases usually are, under circumstances of free intercourse;" and the conduct of the Pestilence, in this respect, at Ely and Plymouth, and at Moscow, is referred to in support of the statement.

In opposing such evidence as that here abundantly supplied under the first two rules, it is not stated, that the Pestilence *did* advance with a rapidity *greater* than that of human intercourse, which would be sufficient disproof: it is only attempted to show that the coincident circumstances of Cholera keeping pace with human intercourse, and appearing in distant places after the recent arrival of ships or persons from infected places, *might* be mere accident. As to the progress of the disease along the chief lines of human intercourse, if it only crept along by the chief lines, the objection of its being under such circumstances more attractive of observation would have more weight. Such, however, has not been the case; for in the above extracts we have instances recorded of

individuals conveying the disease to a considerable distance, the Pestilence spreading in places in this manner infected, as it does in others situated in the lines of great communication. This much we are bound to say in commenting on the arguments or proofs advanced on both sides; but we do so without any desire to abet either party,—simply wishing to elucidate truth, on whichsoever side it may be found.

The testimony, collected from Dr. Copland's article, which can be applied by the third rule, is now to be given; the rule is

3rd,—When the Pestilence is prevailing in a district, certain places, either from being in a thinly peopled part of it, or from holding no communication with infected localities, altogether escape infection; or, after a period of exemption, on some accidental, though accountable, introduction of the disease from without, it rapidly extends its ravages among the previously healthy.

"When the disease appeared in Aleppo, in 1822, the French consul, M. De Lesseps, convinced of its infectious nature, placed himself, his family, and all those who wished to join him, in strict quarantine, in a place adjoining the town. This colony, consisting of about 200 persons, remained perfectly secure from the disease, although 4,000 persons died of it in the city. If it proceeded from some unknown state of the air, as supposed by the anti-infectionists, to what cause can we impute the escape of those who had so

secluded themselves, for they surely must have breathed the same air as those who were affected? M. Hubenthal states, that a peasant having arrived from Arkatal, on the borders of Persia, at the village of Neskutshne, to visit an uncle, was seized, the night of his arrival, with the disease. The persons engaged in restoring the heat of the body by frictions, &c., four in number, were attacked on the following day, and three of them died. Precautions were taken by the police to arrest the progress of the Pestilence in the village, and it spread no further. If the causes of the seizure had existed in the air, or state of the locality, how came all the inhabitants, excepting those who had been exposed to the inhalation of the effluvium from the affected person to escape?" "The introduction of the Pestilence into St. Petersburg is referred by Drs. Barry and Russell to the arrival of vessels from places on the Wolga where it prevailed. In that capital the infectious nature of the disease was shown, not only by the mode in which it was propagated in various quarters, and by its introduction into, and extension through, the prisons and hospitals of the city, but also by its exclusion from some places by a rigid insulation." "There were one hundred and fifty pupils on the officers' side (Military Academy at Cronstadt), which is kept perfectly distinct from the school for petty officers and sailors. The gates were shut on the 19th of June, and as strict a quarantine as possible

maintained to the 6th of August (O. S.). No case occurred amongst the pupils, who are from nine to twenty years of age." In the instance of the nobleman's coachman, in the government of Pensa, already related, the effect of seclusion was put to the test; thus, "The doctor arrived in time to see the fourth case; and, finding that the disease spread on that side of the village, he had the street barricaded on the side where it had not reached, and interdicted all communication to the two sides of the village. In that side in which the disease first broke out, upwards of one hundred cases of Cholera occurred, of whom forty-five died, but it did not appear on the other side of barricade."

On this point the evidence, although satisfactory as far as it goes, is certainly, in a numerical respect, more feeble than on the other two; while the objections directed against it are contained in these few words, already given in the argument of Dr. George Budd against the infectiousness of Pestilential Cholera;—"Quarantine regulations have totally failed to prevent its advance." On this part of the argument for the infectiousness of the disease,—as much more information is needed,—we will not dwell, and, therefore, hasten to place before our readers the important evidence, to be found in Dr. Copland's article, accordant with the fourth and last rule.

4th,—In an infectious disease, the friends and attendants,—the medical men and nurses,—are, from

their greater exposure to the exciting cause, expected to sicken of it in a proportion greater than the general average.

Under this rule we look for the most important proofs for, or against, the alleged contagiousness of Pestilential Cholera. "Amongst numerous other instances the following may be mentioned;—Up to the 13th of July, fifteen hospital physicians were attacked by the disease" (at St. Petersburg); "and the proportionate number of attendants of all descrptions on the sick, who have been taken ill with Cholera, is fully greater than that of the medical men." (Report of Drs. Barry and Russell.)

"Dr. Taylor reports that 'whenever the disorder appeared in any particular spot or family, a considerable proportion of the family or neighbours were attacked within a very short period of each other: on many occasions I have seen three or four of a family lying sick at once.' (p. 195.) Dr. Burrell informs us, that in the short space of six days every attendant, in his hospital, on the patients affected with Cholera had the disease.—(Bombay Report, p. 9.) And Mr. Craw states, that every one of the attendants, thirty in number, in the hospital of the 65th regiment, were attacked." The following is from the report edited by Mr. Jameson:—"A Sepoy died of the Pestilence. Five of the corps, who had shown no signs of illness, were employed to carry the body to the grave. They were all seized with the disorder

during the ensuing night, and all died." (Calcutta report, p. 130.) "Mr. Train adds, that 'the attacks have shown a great disposition to run in families, and even among the attendants on the sick; and have in such cases been much more severe than usual.' (Madras report, p. 131.) Mr. England observes, that 'the disease has been greatly felt amongst the attendants on the epidemic patients at various places.'" (Op. Cit. p. 170.) Mr. Chapman, after stating facts perfectly in accordance with those furnished by the reporters already quoted, adds, that he feels most confident of having experienced the attack of the disease, under which he had with difficulty recovered, from infection. Being anxious about a patient, he remained with him for several hours, watching the progress of the disease. He felt nausea on quitting him, but attributed it to the peculiar fœtor evolved from the evacuations On the following morning he was attacked with Cholera, which nearly proved fatal. He proceeds—In the same detachment, a woman, anxious about the safety of her child, slept in the hospital tent, in which several Choleric cases were present; in the morning she was attacked with the disease, and died. Three orderlies, also, slept in the hospital, and in the morning one of them was attacked, but recovered. 'Thus, it will be seen, four persons sleep in an hospital containing the infection of Cholera, and that two are, on the following morning, attacked with the disease—whereas, from

the whole camp, consisting of 1500 or 1600, not five cases had occurred. That the disease is contagious appears to have been observed by the natives themselves, and it thus commonly happens that the sick are avoided by those whose duty does not call on them to attend. A village in which Cholera is prevailing is usually evacuated for a short period, until the disease is annihilated; these, and many others, are the proofs of their opinion of its contagious nature.' (p. 189.)

"Mr. Stokes, in his comprehensive report, states several well-ascertained facts, showing the infectious nature of the disease. The case of Mr. Rumbold, assistant-surgeon is almost demonstrative of this property. He had been visiting some very bad cases, when he was seized with sickness at his stomach, and giddiness; and coming out of the tent, he fell down faint, and from that period he believed himself infected with the malady. He soon became one of its victims. The sickness and faintness with which Mr. Rumbold, in a state of high predisposition 'from fatigue of mind and body,' was affected, may be easily accounted for by the information which Mr. Stokes gives in the following page. He states, that in the worst cases—'a peculiar and offensive fœtor was observed to issue from the body, particularly when it was covered with much sweat; it was very disagreeable when first perceived, and seemed to hang about the nostrils, exciting, long after, an unpleasant

sensation.' (p. 211.) In another place, he remarks, 'It was found amongst many who came to the hospital, that some time previous to their being attacked, the disease had existed in the family, to a greater or less extent, or some one branch had been ill or died of it. In others, it had spread progressively through the whole, or nearly; and among those who officiated as orderlies or attendants at the hospital, several were attacked, and some died.'" (p. 217.) "Dr. Daun, whilst he refrains from giving any opinion as to the contagious nature of the disease, states the following facts in proof of it:—'On the 10th, when in attendance on O'Brien, I became indisposed in such a way as to lead me to apprehend an attack of the epidemic. On the 12th, Mr. Gray was attacked, after having been up part of the night with Thomas Flannigan. Mr. Gray was, during his illness constantly attended by Lieutenants S. and M'D., who have since had both of them attacks of the epidemic, and no other officers except them at this station have been attacked. (Op. Cit. p. 273.) And lastly, as respects the official reports, Mr. Kellie furnishes both facts and arguments, many of them similar to those already adduced, in support of the infectious character of the Pestilence." (pp. 68—77.)

Opposed to this string of evidence we have the statement of Dr. George Budd that "the medical men and attendants on the sick have not generally been attacked in undue proportion;"—a statement sustained by experience in the Dover and Echo—

Cholera hospital ships ;—by the recorded observations of Dr. Mackintosh at the Drummond Street Cholera hospital, Edinburg ; and, in a degree, by the reports of Drs. Barry and Russell. These have already been quoted in detail, from Dr. George Budd's paper, in a former part of this chapter (p. 54-56); and we request our readers to refer to them, and compare them with our extracts from Dr. Copland's work.

In leaving this *quæstio vexata* of medical science to the judgment of our readers, individually, we feel bound to say, in justice to Dr. George Budd, that his paper bears no impression of its being intended as a full exposition of the argument of the non-contagionists ; and, therefore, in all probability, it was deemed unnecessary to burden it with a multitude of reported facts, supplied by the abettors of his view. Hence, the reader must not suppose, that our quotations from the paper of the above-named author contain all that can be said in defence of his argument ; but must rather view them as a specimen of the *manner* in which such defence is conducted. Without this explanation, many, who are unread in the controversy, might, without due consideration, give the palm to the contagionists.[1]

[1] Dr. Parkes states (' Op. Cit.,' p. 190), "I have never observed any indication of contagion. In common with the great majority of Indian writers, my evidence is on the negative side. When Cholera prevailed for months in Tenasserim, and traversed indeed the whole of Eastern Asia, I never heard human intercourse alleged as a means of introduction into any place."

The dispute about the contagiousness of Cholera, when settled, would still leave the enquiry,—'What is the cause?'—unanswered. That a virus,—a materies morbi,—exists in Pestilences few are disposed to doubt; but of the nature of that virus writers are up to the present time, as much in the dark, as in the days of Galen. In conformity with the plan of our work we have to glance at some of the existing opinions on the cause of this Pestilence: and, as it appears probable, that in all Pestilences the materies morbi is *generically* the same, we shall take into view opinions generally referring to such diseases, as well as those specially applicable to Pestilential Cholera.

Mr. Adams, the accomplished commentator on 'Paulus Œgineta' (Syd. Soc.), after the passage containing the opinion of the last-named ancient author on epidemic diseases, in which the following occurs:—"The nature of the country will also often occasion common diseases, either from its lying adjacent to marshes, or to some deep pit, which emits a deleterious and pernicious exhalation"—supplies a very elaborate commentary compiled from ancient authors on the subject. We are compelled to confine ourselves to very concise extracts. The opinion of Hippocrates on this point is thus given: (vol. i., p. 274)—he states, that "diseases in general may be said to arise either from the food we eat or the air we breathe. When, therefore, a disease seizes on a

multitude of persons of different ages, sexes, and habits, he justly infers that it must arise from the latter cause." Galen is stated to have taken a similar view of the cause of pestilences; thus, he "attributes the origin of epidemics to the state of the atmosphere in a great measure, but also holds that the nature of the country may contribute: as, for example, its vicinity to a gulf like the Charonian, from which miasmata are exhaled that taint the air and occasion diseases." "Silius Italicus appears to refer an epidemical fever to the same cause." "Of the Greek authors posterior to Galen, Oribasius and Aëtius give the same account of epidemical diseases as our author; and the others either do not treat of them at all, or class them with the subject of our next section."

"Avenzoar has given us an elaborate treatise on epidemical complaints. The first cause of them which he mentions is a humid and warm state of the atmosphere, such as that to which Hippocrates ascribed the Pestilence which afflicted Thasus in his time. The other causes enumerated are the effluvia from dead bodies, stagnant air, the miasmata from stagnant and corrupted waters, and unwholesome food."

"On the origin of epidemical diseases, especially the Pestilence, see, in particular Haly Abbas. The principal causes of the change of the atmosphere to a pestilential state, according to Haly, are the nature of

the country and the season of the year." "According to Diodorus Siculus, the causes which gave rise to the Pestilential Epidemic which attacked the Carthaginian army in Sicily, were the marshy nature of the country in which they were encamped, the bodies of the dead lying unburied, and the excessive heat of the season. He ascribes the Plague of Athens to similar causes." Mr. Adams was led, by his laborious investigations into the opinions of the ancients on the subject of contagion in Plague, to conclude that, if not all, at least the most intelligent medical authorities believed that the Plague was communicated, not by a specific virus, but in consequence of the atmosphere around the sick being poisoned by putrid effluvia. ('Op. Cit.' vol. 1. p. 287.)

From times the most ancient there has been a prevailing belief that visitations of the Plague, and of other Pestilences, have been preceded or accompanied by terrestrial or meteorological phenomena of an extraordinary kind. Thus the celebrated Plague at Athens is stated by several writers to have been prognosticated by earthquakes, comets, and other celestial fires. Dr. Hecker, too, in his account of 'The Black Death'—the Plague—which devastated Europe in the 14th century, after narrating wonderful disturbances within the earth and upon its surface, which had premonished its inhabitants of coming calamity, adds "The insect tribe was wonderfully called into life, as if animated beings were destined to

complete the destruction which *astral* and *telluric* influences had begun." Another deservedly popular author has in modern times remarked that some of our more recent epidemics have been announced by meteorological phenomena; and has, like Hecker, suggested that the superabundance of insect organisations, then called into being, may have lent its agency towards the production of epidemic diseases. The opinion of the author of 'The Black Death,' as to its cause, may be gathered from the words with which he concludes the chapter (p. 21.) "This disease was a consequence of violent commotions in the earth's organism—if any disease of cosmical origin can be so considered. One spring set a thousand others in motion for the annihilation of living beings, transient or permanent, of mediate or immediate effect. The most powerful of all was contagion; for in the most distant countries which had scarcely yet heard the echo of the first concussion, the people fell a sacrifice to organic poison, the untimely offspring of vital energies thrown into violent commotion."

Sydenham ascribed pestilences to two causes, acting concurrently, viz., a secret disposition of the air, and an effluvium or seminium; and in the same chapter, admitting his inability to define what "the essence of the Plague" is, he compares the unreasonableness of the demand of such definition to that of enquiring, what it is that constitutes the cause of

the specific distinctions in animals or plants, as of a 'horse' or 'betony.'—He does, nevertheless, in a subsequent chapter, venture a little way into the realms of speculation in regard to the nature of the "seminium or effluvium," assumed by him to constitute the essence of epidemic and pestilential diseases: thus, he writes,[1] "But I conceive it more probable, that a certain particular tract of air becomes replete with *effluvia* from some *mineral* fermentation, which infecting the air through which they pass, with such particles as prove destructive sometimes to one kind of animals, and sometimes to another, continue to propagate the diseases peculiar to the various dispositions of the earth, till the subterraneous supplies of those *effluvia* fail; which may likewise undergo a new fermentation from the remains of the old matter, as in the case just mentioned."

In the present day the most able opponents of the doctrine of contagion appear to lean towards the notion of pestilences originating in some peculiar property of the atmosphere; for instance Dr. George Budd (Op. Cit. Vol. iv. p. 110.) says of Cholera,—"We can account for the phenomena only on the supposition of some peculiar atmospheric condition, capable of unlimited diffusion, but rendered more active by the local circumstances that have been found most conducive to the disease." In a note, he

[1] 'Sydenham's Works,' by Dr. Swann (1749), p. 203.

expresses his opinion that the suggestion of Dr. Holland, as to the course of Cholera being represented by the propagation and migration of insect swarms, is more accordant with the facts noticed in his paper, than any other hypothesis then put forth. On the other hand the eminent contagionist—Dr. Copland—to whom we are already so much indebted, supposes that the seminium must be an *animal poison* (Op. Cit. p. 121, et passim) generated in the human body; he thus explains his views (P. 121.),—"This morbid effluvium or seminium of the distemper—this animal poison emanating from the infected—was often made manifest to the senses of smell and even of taste; it attached itself to the body and bedclothes, remained so attached for lengthened periods, if these clothes were shut up in confined places; and reproduced the disease when the air respired by predisposed persons was contaminated or infected by the clothes imbued by the effluvium or poison."

We have not space for a more lengthened research into the assumed causes of Pestilential Cholera; we shall, accordingly, bring this chapter to a close with a quotation from the 46th No. of the 'British and Foreign Medical Review,' (April, 1847,) which supplies a summary of the views of the cause, promulgated to the present time. The article is a review of the works of 'Copland, Kennedy, Lorimer, Holland, on the causes and propagation of Asiatic Cholera:'—and in the page, from which we are going to quote,

it is suggested that a compromise between the two extreme opinions, but little likely to conciliate either party, may nevertheless best comport with truth;—that is, that the disease ordinarily propagated by other agency than that of reproduction in the human system, may yet sometimes be so reproduced, and,—*pro tempore et pro tanto*,—be contagious. The following are the "hypotheses which have been formed as to the nature of the agent causing it" (Pestilential Cholera).

"1. The disease has been considered by some to be entirely atmospheric; that is, produced by changes in the ponderable or imponderable elements of the air without the addition of some new ingredient. This hypothesis is contradicted, however, by all the phenomena, which seem decidedly to point out the presence of a virus derived from sources foreign to the atmosphere, and merely existing in it.

"2. The materies morbi has been supposed to be a modification of vegetable miasma, produced by peculiar causes of heat, moisture, &c., acting on the productions of the soil.

"3. It is supposed to be an agent evolved from the crust of the earth, and produced by volcanic and other changes. This has been a favorite hypothesis in all epidemics, and many curious coincidences between earthquakes, volcanic eruptions, &c., and epidemic diseases have been collected in the extraordinary work of Noah Webster, and in Hecker's 'Epidemics of the Middle Ages.'

"4. Another party, leaving in obscurity its origin, regard it when witnessed by us as always allied to the human system. This is the contagious doctrine as developed by Copland, Becker, and others.

"5. It has been surmised to be caused by animal life, existent in the atmosphere under certain circumstances."

Here we take leave of 'the Cause of Pestilential Cholera,' reserving our own opinion for the second part of the work, which will be principally devoted to the attempted elucidation of this hitherto unknown agent.[1]

[1] There is much valuable information on this head to be found in the recent work of Dr. Parkes, in the chapter on 'the Diffusion of the Choleraic Poison;' to which we must refer our readers, as we have space only for a brief quotation. He says (p. 156), "I have throughout this treatise assumed the existence of a special morbid agent or virus, by whose action or predisposing frames, the disease termed Cholera is produced. It is true, that the argument for the existence of this virus is only analogical, for chemistry as yet takes no cognizance of the more subtle gases. But when the peculiar mode of spreading of the Cholera is taken into account, with the absence of any uniform atmospheric changes attending its attacks, we must admit that the presence of a materies morbi, or septic agent, is infinitely more probable, than that a disease so uniform in its characters should be produced by atmospheric changes, inappreciable by meteorological instruments. What this poison may be, from what sources it is derived, whether it arose during some convulsion of nature, some strange aberration of seasons, or whether the ordinary decomposition of vegetable or of animal life produced it, is at present absolutely unknown.

"I am very far from meaning to assert, however, that meteorological conditions are not necessary for the development of the virus. The numerous observations made on this point, both in India and Europe, confessedly imperfect as they are, point with tolerable certainty to the necessity for certain conditions, without which the virus dies or becomes dormant."

CHAPTER V.

THE TREATMENT OF PESTILENTIAL CHOLERA.

On this branch of our enquiry we shall endeavour to be very brief; so little satisfied are practitioners who have treated Cholera abroad, or at home, with the several methods of treatment hitherto proposed for the worst grades of the malady. That treatment by medicine, to be at all efficacious, must be practised very early in the disease, is rendered by past experience sufficiently obvious; and, indeed, the medicines administered by the mouth, in the later stage of severe cases are frequently unabsorbed, and have repeatedly been found in the stomach after death. In the milder forms of the Pestilence, and in the premonitory stages of the severer cases,—where premonition is afforded,—treatment can, however, accomplish much good; and in this way it has rescued thousands from the grave.

In the train of symptoms, of which an attack of Cholera, protracted beyond a very few hours, is composed, some of these will be the immediate fruits of the impression, made by the morbific agent itself;

but others will be *the consequences* of the derangement of circulation, and arrest of nutrition, as well as of the merely altered nature of the blood. The observations, to be made under this head, must, therefore, be understood to apply only to the morbid impression supposed to be made by the virus on the blood, and its immediate manifestations: the congestions of organs, and sequelæ in general, being regarded as secondary, and to be treated on general principles, need not receive any of our attention in an enquiry like the present. First, let us examine by what agents the disease itself has appeared to be most controlled, and what are the remedies of best repute in procuring immunity from an attack of Pestilential Cholera.

Dr. Billing[1] says, "I have depended much upon antim. tartariz. with or without neutral salts, and resorted less to bleeding, and with more flattering success." In a note are subjoined two cases, one severe, the other slight,—illustrating his principle of treatment by sedatives, which he thus concludes[2] "in the absence of tartar emetic or epsom salts, I could have treated the case with the sedatives employed by other practitioners, acetate of lead, ipecacuanha, common salt, &c."

Dr. Pereira,[3] in detailing the medica luses of calomel, writes,—"I have now before me reports of eighteen

[1] 'Principles of Medicine,' 4th edition, p. 242. [2] p. 244.
[3] 'Mat. Med.,' vol. i., p. 470.

cases of spasmodic Cholera, admitted in the year 1832 into the Cholera Hospital at Bethnal Green, in this metropolis, in which enormous quantities of calomel were employed by the house-surgeon, Mr. Charles Bennett (formerly one of my pupils), with very slight physiological effects. When a patient was brought into the hospital, two drachms of calomel were immediately given, and afterwards one drachm every one or two hours, until some effect was produced. In seventeen out of eighteen cases in which this plan was tried, the vomiting and purging diminished, and the patients recovered. Several of them took from twenty to thirty drachms without the subsequent ptyalism being at all excessive. In one case (a female aged thirty-six years), thirty one-third drachms were administered within forty-eight hours, moderate ptyalism took place, and recovery. In the unsuccessful case which I have alluded to, fifty-three drachms of calomel were administered within forty-two hours, without the least sensible effect." Dr. Graves, of Dublin, has recommended with much earnestness the administration of acetate of lead. He gives it with opium; a scruple of the acetate of lead and a grain of opium are made into twelve pills, of which, *during collapse*, one is given every *quarter of an hour*, but otherwise every hour, or once in two, three, or four hours, according to the urgency of symptoms. Emetic medicines are much recommended, and those of a stimulant kind are preferred,—by some, mustard,—by Dr. Copland,

sulphate of zinc. Mr. Corbyn in India relied on calomel (fifteen—twenty grains) oil of peppermint (twenty drops) and laudanum (sixty drops) for a dose. Peppermint and cajeput oils were generally employed in India. The medical commission at Astrachan commenced their treatment as we have seen Mr. Corbyn did, with large doses of calomel, peppermint, and laudanum. Similar practice was adopted in Russia.

Dr. Copland[1] says that the symptoms of the disease soon followed the first morbid impression, which, the experience of himself and medical friends convinced him, was one of depression, "if the primary morbid impression was not removed by *powerful stimulants and tonics.*" In the mildest forms of the disease, he states, that "warm astringents and stimulants" are most worthy of reliance, enumerating sulphate of zinc, capsicum, opium, aromatic confection, confection of black pepper, extract of logwood, sulphate of alumina and acetate of lead. Nearly all the kinds of aromatic and essential oils are recommended by Dr. Copland in one part or other of the treatment of the various grades of severity of this disease, as the reader may satisfy himself by referring to the article from which we have been quoting, and particularly to paragraphs 195 and 196.[2]

[1] 'Dict. of Pract. Med.,' Art., Pestilence Choleric, p. 129.

[2] The following are some of the recorded observations of Dr. Parkes, from his experience in treating this disorder in India: he recommends blood-letting and astringents in the first stage, and "a strong stimulus at the very commencement of this stage." The only cases

Blood-letting has fewer advocates now than formerly, and, except in rare cases of peculiarly robust persons with marked indications of congestion of organs,—in which local abstraction of blood may be advantageously prescribed,—it is no longer deemed worthy of reliance. Cases may occur also, which, in the sequelæ of the disease, require this remedy.

The saline treatment, so earnestly recommended to the profession by Dr. Stevens, has advocates as few, as has the last named remedy. This, however, is not without benefit in the stages of convalescence, with a view to a restoration of the lost saline constituents of the blood; for which purpose the prescription of Dr. Stevens has been advised by practical men.

in which blood-letting was unequivocally useful, were uniformly of a mild character. "Of all the astringents which have been used in Cholera, none has appeared to me so efficacious as the one recommended by Dr. Graves, viz., the acetate of lead." (p. 207.) "The sulphate of copper and of zinc seemed also occasionally to restrain the purging; but these remedies are not so readily borne by the stomach, and are therefore inferior in practical value to the acetate of lead." (p. 208.) "The list of remedies which have been used in Cholera with this indication" (to counteract the deeper and more important changes in the blood), "comprises all the stronger medicines known to physicians at the present day, and as it appears to me, no one medicine has been found more uniformly efficacious than another. The occasional mildness of an epidemic, or the use of a medicine towards its close, when the cases are less severe, have indeed conferred a temporary repute on certain remedies, but the next epidemic has invariably shown the boasted specific to be in reality as useless as any other, in the long array of medicines which have had an equally undeserved and equally transient popularity." (p. 209.)

The adoption of the saline treatment,—modified in the mode of administration—by injection into the veins, first proposed and practised by Dr. O'Shaughnessey, and extensively tried, in the most desperate cases, by Dr. Macintosh and others, has also failed to realise the first fond hopes of its success. The symptoms, under the treatment by saline injection, were usually for a time much mitigated, but only to disappoint the expectation, thereby raised.[1] The result of this practice is sufficient evidence, that the disease does not consist merely in the loss of the serum of the blood.

Various other remedies have been applied, according to special indications in the treatment of this comparatively uncontrollable disease; for instance,—frictions with stimulating and aromatic embrocations; aromatic fumigations; enemata, containing oil of turpentine, assafœtida, &c.; the hot air bath; cold affusion; &c. For the method of employing these, reference may be made to any of the numerous treatises on this subject, that have been published since the visitation of the Pestilence, experienced in this country in 1832, 1833, and 1834. But as it is not our purpose to enter more fully into this branch of the subject, than is requisite for the elucidation and support of the argument contained in the second part, we must here take leave of it.

[1] The injection of a saline solution of albumen, tried by Dr. Parkes in five cases ('Op. Cit.,' p. 219—240), though unsuccessful, produced such temporary results, as to encourage a further trial of it in less hopeless cases.

PART II.

FUNGOUS ORIGIN OF PESTILENTIAL CHOLERA.

CHAPTER VI.

PRELIMINARY OBSERVATIONS.

The view of the proximate or exciting cause of Pestilential Cholera, about to be unfolded in the remaining chapters, will, it is hoped, tend to a reconciliation of some of the conflicting opinions hitherto entertained on this and kindred subjects. We are about to attempt to frame a reply to the vitally important question,—'What is the nature of the virus,—the effluvium,—the materies morbi of pestilential diseases, and, as amongst these, of Pestilential Cholera?'

The morbific matter of Pestilences, whatever it be, offers to our observation phenomena so similar, however various the phases of disease communicated by its instrumentality, that, by whatever laws its agency may be controlled, such laws may be fairly assumed to be uniform: nor shall we find ourselves unsupported by the opinions of some of the best

informed on these matters, if we regard the varying manifestations of it in the several disorders, propagated by its means, as so many species of one genus.

From what the author has read on the subject of Pestilences in general, and especially from what has referred to Pestilential Cholera, it is inferred that so close an analogy exists between the generation and propagation of the pestilential virus of the above-named disease, and the phenomena observed in the development of the lowest orders of the vegetable creation, as to warrant the conclusion, that between this virus and the germs of some species of Protophyta—Fungi—there exists a positive identity. It is, further, believed that under circumstances of warmth, moisture, and electrical constitution, highly favorable to the generation, propagation, and diffusion of the lowest forms of vegetable beings, germs (sporules) of fungi, or other protophytic growth, were inhaled with the atmospheric air, and with it were absorbed into the blood. That persons, bio-chemically (electrically) predisposed, suffered from the rapid germination in the blood of the germs, thus admitted,—the fungous cells robbing the plasma of the blood of some of its nutritious properties, and also, by the catalytic action set up, altering its chemical properties, and probably producing in it some deleterious new ingredients,—thus diminishing, on the one hand, those nutrifying metamorphoses throughout the peripheral system, on which the body is dependent for its heat and its

health, and, on the other, adding poison in the place of the aliment removed.

Dr. G. E. Day,[1] in describing the primary substances composing the greater portion of animal and vegetable matter, viz., Fibrine, Albumen, and Casein, after stating Mulder's discovery of these being all modifications of one compound—Protein, proceeds to say "that Protein, in every respect identical with that which forms the basis of the three aforesaid animal principles, may be obtained from similar elements in the vegetable kingdom;" and in the next page quotes Liebig,[2]—"The chemical analysis of these three" (vegetable) "substances has led to the very interesting result, that they contain the same organic elements united in the same proportion by weight; and, what is still more remarkable, that they are identical in composition with the chief constituents of the blood, animal fibrine and albumen."

The Fungi, consisting principally of protein compounds, and in many species existing in a cellular form, as in *Protococcus nivalis* (red snow), *Torula Cerevisiæ* (yeast plant), and many others, might, it is presumed, under peculiar circumstances—probably of diminished vitality of the human frame—become naturalized in the living secretions, and particularly in the blood. In this latter fluid there would be

1 'Animal Chemistry,' &c., &c., by M. Simon, translated by Dr. G. E. Day, (Syd. Soc.) vol. i., p. 5.

1 Liebig's 'Animal Chemistry,' translated by Gregory, p. 47.

instantly set in operation a process, resembling that created in vegetable substances on the addition of a ferment,—a process of Catalysis, followed by the results already described. The viscidity of the blood in Pestilential Cholera, as also the "viscid" state of the peritoneum, and the mammellated appearance of the mucous membrane, described by Dr. George Budd,[1] among the anatomical characters of this disease, so analagous to what is found to occur in grasses which have absorbed the germs of the fungus —*ergotœtia abortefaciens*, are probably other effects issuing from this Catalytic action attending the vegetation of fungous germs,—possessed of an ultimate composition scarcely alienating them from the animal kingdom, and reproduced in a manner not dissimilar to that in which, according to Schwann and Schleiden, most living organisms, animal and vegetable, are built up.

This hypothesis of the genesis of Pestilential Cholera is supported by the analogy, existing between the assumed decomposition of the blood in that disease, and the changes effected in organic liquids on the addition of yeast,—now known to consist of a fungous growth *(Torula Cerevisiæ)*; by the similarity of the circumstances favoring the production of Fungi, and those attending the origin and spread of that pestilence; and, in a great degree, by the identity of many of the remedial agents recommended in this

[1] 'Op. Cit.,' vol. iv., p. 114.

disorder from an experience of their efficiency, with those agents known most effectually to prevent or destroy the ravages of fungous growths in organic substances. The patient attention of the reader is requested while these several parts of our subject shall be considered in detail. But with a view to render more intelligible the arguments of the writer, it may be desirable, first to dwell somewhat more at length on a description of the nature and properties of Fungi, and then proceed to the development of the several parts of the analogy, supposed to exist between the virus of Pestilential Cholera and some of the lowest orders of these Protophyta.

What is the nature of Fungi? (The nearly allied Algæ, differing according to Lindley only in their predilection for a fluid habitat, while the pure Fungi seek for themselves a nidus of firmer consistence, are here included in all the remarks referring to the latter order.) Do they belong to the *vegetable* kingdom? Or may not a place be more properly assigned to them among the Phytozoa—the lowest order in the *animal* series? We are here confronted with a difficulty, which very able naturalists have not been able satisfactorily to overcome;—for, it is well known, that the chemical composition of fungi nearly approaches that of the lowest grades of animal organisation; while, together with this animal composition, some species of this order, the Diatomeæ and Oscillatoriæ, possess a power nearly resembling voluntary motion.

The substance, of which the beings of this order chiefly consist, is by chemists named Fungin and is thus described in 'Turner's Chemistry';—"This name is applied by M. Braconnot to the fleshy substance of the mushroom purified by digestion in hot water to which a little alkali is added. Fungin is nutritious in a high degree, and in composition is analagous to animal substances. Like flesh, it yields nitrogen gas when digested in dilute nitric acid." (4th Ed., p. 837.)

But the descriptions of these protophyta, as given by Berkeley and Lindley, will convey to the reader a more accurate idea of these low organisms, and some of their most remarkable appearances. "Essential Character.—*Plants* consisting of *cells* and *fibres*, always springing from organized, and generally decayed or decaying substances, not perfected when immersed in water, bearing reproductive *sporidia*, either externally or internally, naked or inclosed in variously-formed cells, many of which frequently concur in the reproduction of a single individual, varying extremely in substance and duration, generally soft and juicy, sometimes exceedingly hard, with or without a central gelatinous nucleus, or dry and powdery." *(Berkeley.)* The following extracts from Professor Lindley's[1] descriptions of Fungi and Algæ will also afford useful matter for illustration of our subject. "Affinities.—These are only distin-

[1] 'Introduction to Natural System of Botany,' p. 334, et seq.

guished from Lichens by their more fugitive nature, their more succulent texture, their want of a thallus or expansion independent of the part that bears the reproductive matter, and by the latter being contained within their substance and not in hard distinct nuclei originating in the centre and breaking through a cortical layer. From Algæ there is no absolute character of division, except their never growing in water; in fact, it is, as has been before stated, rather the medium in which Fungi and Algæ are developed that distinguishes them, than any peculiarity in their own organisation: for instance, the aerial Byssaceæ, which are Fungi, are nearly the same in structure as the aquatic Hydronemateæ, which are Algæ. While there is so near an approximation of these families to each other, particularly in the simplest forms, it is important to remark that no spontaneous motion has been observed in Fungi, which, therefore, cannot be considered so closely allied to the animal kingdom as Algæ, notwithstanding the presence of azote in them, and the near resemblance of the substance by chemists called Fungin, to animal matter.

"Fungi are almost universally found growing upon decayed animal or vegetable substances, and scarcely ever upon living bodies of either kingdom; in which respect they differ from Lichens, which very commonly grow upon the living bark of trees. They are, however, not confined to dead or putrid substances, as is shewn by their attacking various plants

when in a state of perfect life and vigour. In their simplest form they are little articulated filaments, composed of simple cellules placed end to end; such is the mouldiness that is found upon various substances, the mildew of the rose-bush, and, in short, all the tribes of Mucor and Mucedo; in some of these the joints disarticulate, and appear to be capable of reproduction; in others sporules collect in the terminal joints, and are finally dispersed by the rupture of the cellule that contained them. In a higher state of composition, Fungi are masses of cellular tissue of a determinate figure, the whole centre of which consists of sporules either lying naked among filaments as in the Puff-balls, or contained in membranous tubes or sporidia, like the thecæ of Lichens, as in the Sphærias. In their most complete state they consist of two surfaces, one of which is even and imperforate, like the cortical layer in Lichens; the other separated into plates or cells, and called the hymenium, in which the sporules are deposited."

"Some writers have questioned the propriety of considering Fungi as plants, and have proposed to establish them as an independent kingdom, equally distinct from animals and vegetables; others have entertained doubts of their being more than mere fortuitous developments of vegetable matter, called into action by special conditions of light, heat, earth, and air—doubts which have been caused by some

remarkable circumstances connected with their development, the most material of which are the following:—They grow with a degree of rapidity unknown in other plants, acquiring the volume of many inches *in the space of a night, and are frequently meteoric, that is, spring up after storms, or only in particular states of the atmosphere.*" (This passage is italicized by the author of this work.) "It is possible to increase particular species with certainty, by an ascertained mixture of organic and inorganic matter exposed to well-known atmospheric conditions, as is proved by the process adopted by gardeners for obtaining Agaricus campestris; a process so certain, that no one ever saw any other kind of Agaricus produced in mushroom-beds; this could not happen if the mushrooms sprang from seeds or sporules floating in the air, as in that case many species would necessarily be mixed together; they are often produced constantly upon the same kind of matter, and upon nothing else, such as the species that are parasitic upon leaves: all which is considered strong evidence of the production of Fungi being accidental, and not analogous to that of perfect plants. Fries, however, whose opinion must have great weight in all questions relating to Fungi, argues against these notions in the following manner:—'Their sporules are so infinite (in a single individual of Reticularia Maxima I have counted above 10,000,000), so subtile (they are scarcely visible to the naked eye, and often

resemble thin smoke), so light (raised, perhaps, by evaporation into the atmosphere), and are dispersed in so many ways (by the attraction of the sun, by insects, wind, elasticity, adhesion, &c.), that it is difficult to conceive a place from which they can be excluded.' I give his words as nearly as possible, because they may be considered the sum of all that has to be urged against the doctrine of equivocal generation in Fungi; but without admitting, by any means, so much force in his statement as is required to set the question at rest. In short, it is no answer to such arguments as those just adverted to. It seems to me that a preliminary examination is necessary into the existence of an exact analogy between all the plants called Fungi; a question which must be settled, before any further inquiry can be properly entered upon."

"Of parasitical Fungi, the most important are those which are called dry rot, such as Polyporus destructor, Merulius lacrymans and vastator, &c., which are the pest of wooden constructions; next to these come the blight in corn, occasioned by Puccinia graminis; the smut and ergot, if they are really anything more than the diseased and disorganised tissue of the plants affected; the rust which is owing to the ravages of Æcidiums; and finally, in this class is to be included what we call mildew, minute simple articulated Mucors, Mucedos, and Byssi."

In describing the next order 'Algæ,' Dr. Lindley has these remarks,—"Those who have ever examined

the surface of stones constantly moistened by water, the glass of hothouses, the face of rocks in the sea, or of walls where the sun never shines, or the hard paths in damp parts of gardens after rain, cannot fail to have remarked a green mucous slime with which they are covered. This slime consists of Algæ in their simplest state of organisation, belonging to the genera Palmella, Nostoc, Red Snow, and the like, the Nostochinæ of Agardh, or Chætophoroidæ of Greville; they have been called Chaodineæ by Bory de St. Vincent, whose account of them is to the following effect:— The slime resembles a layer of albumen spread with a brush; it exfoliates in drying and finally becomes visible by the manner in which it colours green or deep brown. One might call it a provisional creation waiting to be organised, and then assuming different forms, according to the nature of the corpuscles which penetrate it or develope among it. It may further be said to be the origin of two very distinct existences, the one certainly animal, the other purely vegetable. This matter lying among amorphous mucus consists in its simplest state, of solitary, spherical corpuscles, (such as are figured by Turpin in the 'Mémoires du Muséum,' vol. 18. t. 5.; and as may be easily seen in the common green crust upon old pales, Palmella botryoides); these corpuscles are afterwards grouped, agglomerated, or chained together, so producing more complex states of organisation. Sometimes the mucus, which acts as the basis or matrix of the corpuscles,

when it is found in water, which is the most favorable medium for its development, elongates, thickens, and finally forms masses of some inches extent, which float and fix themselves to aquatic plants. These masses are at first like the spawn of fish, but they soon change colour and become green, in consequence of the formation of interior vegetable corpuscles. Often however they assume a milky or ferruginous appearance; and if in this state they are examined under the microscope, they will be found completely filled with the animalcules called naviculariæ, Lunulinæ, and Stylariæ, assembled in such dense crowds as to be incapable of swimming. In this state the animalcules are inert. Are they developed here, or have they found their way to such a nidus, and have they hindered the development of the green corpuscles? Is the mucus in which they lie the same to them as the albuminous substance in which the eggs of many aquatic animals are deposited? At present we have no means of answering these questions. According to M. Gaillon, many of these simple plants are certainly nothing but congeries or rows of the singular and minute animalculæ called vibrio tripunctatus and bipunctatus by Müller, strung end to end. See Ferusac's *Bulletin, February*, 1824. He particularly applies this remark to Monema comoides.

"Another form of Algæ, one which may be considered a higher degree of development of the last, is that in which they assume a tubular state, containing

pulverulent or corpuscular matter in the inside, and become what are called Confervæ, or, as M. Bory styles them Arthrodieæ. These, which comprehend true Confervæ, Oscillatorias, and many Diatomeæ, are thus spoken of by the acute botanist last mentioned:—the general character of Arthrodieæ consists in filaments, generally simple, and formed of two tubes, of which one, which is exterior and transparent, offers no trace of organisation to the most powerful eye, so that it might be called a tube of glass, contains an inner articulated filament, filled with coloring matter, often almost imperceptible, but at other times very intense green, purple, or yellowish; these compound filaments present to the astonished eye the strangest and most different phenomena, all of which have the plainest characters of animal life, supposing that animal life is to be inferred from motions indicating a well-marked power of volition. The Arthodia tribe usually inhabit either fresh or sea-water, and several are common to both. One of them—but a species referred to the tribe with some uncertainty—the Conferva ericetorum, grows on the ground, but in places that are very damp, and often inundated; others, among the Oscillating species, cover the humid surface of rocks or earth, and the interstices in the pavement of cities; some even grow in hot springs of a very high temperature. (Ulva thermalis lives in the hot springs of Gastein, in a temperature of about 117° Fahrenheit. Ed. P. J. 4. 206.) The most remarkable are, 1st—The

Fragillarias, to which Diatoma and Achnanthes belong; these, when combined in the little riband-like threads which are natural to them, have no apparent action; but as soon as the separation of the joints takes place, a sort of sliding or starting motion may be seen between them. 2ndly,—The Oscillarias, some of which have an oscillatory movement, extremely active and perceptible; and the Ulva labyrinthiformis and Anabaina, which, with all the appearance of a plant, has, according to Vauquelin and Chaptal, all the chemical characters of an animal. 3rdly,—The Conjugatæ, the filaments of which separate at one period, and unite again at another, and finally, by a mode of coupling completely animal, resolve themselves into a single and uniform being; and 4thly,—the Zoocarpeæ, most extraordinary productions, in which the animal and vegetable nature follow each other in the same individual; vegetables in the earlier period of their existence, but producing in the room of sporules or buds, little microscopic animalcules which become filamentous vegetables after a certain length of time. Dr. Greville, in his 'Flora Edinensis,' adopted an opinion of Dr. Fleming and others, that many of the species referred to this group possess an animal structure; such as Diatoma flocculosum, tenue, arcuatum, and obliquatum, and Fragillaria striatula and pectinalis; and he believed Conferva stipitata, Biddulphiana, and tæniæformis of Eng. Bot., together with the whole genus Echinella, to be equally dubious. But he altered this opinion after

two or three years, if we are to judge from his 'Cryptogamic Flora,' in which are beautiful figures of some of the very beings, the animal nature of which is so much to be suspected. For example—Diatoma tenue, a little confervoid plant, with parallelogramic articulations, at first attached by their longest sides, and afterwards separating at their alternate extremities, so as to form a filiform tube. "The filaments," according to an interesting observation of the Rev. Mr. Berkeley, "at a certain period seem to lose the squareness of their figure, to be attenuated at the extremities and dilated in the centre, to become cylindrical and opaque, and, in short, metamorphosed into a moniliform filament, with elliptical or oblong purple joints and colourless articulations." (vol. vi., 354.) Agardh is of opinion that we have among these rudimentary Algæ not only a distinct passage to the animal, but even to the mineral kingdom; for he states that some of his Diatomeæ include vegetable crystals bounded by right lines, collected into a crystalliform body, and with no other difference from minerals than that the individuals have the power of again separating. 'System' xiii. The observations above quoted are those of naturalists of so high a reputation for accuracy, that they may safely be accepted as certain; but I do not know what to say of such as the following, by a German botanist, of the name of Meyen, unless that they require to be verified by others, especially because those who

have sought for the phenomena he mentions have not succeeded in finding them. This writer states that he has seen, very often, a spontaneous motion in Zygnema nitidum; and its filaments contract from the length of ten inches to that of four—six lines; that the Oscillatorias move in a circle; that the globules contained in the filaments of Zygnema have a life partly vegetable, partly animal, and procreate similar globules some of which become animals endowed with motion. See Agardh's 'Species Algarum' 2. 48., from which this account is extracted. Certain supposed Confervæ, called Bacillarias, are rejected from plants by M. Bory de St. Vincent, and placed in the lowest grade of the animal creation. See 'Dict. Class.' 2. 128."

In quoting from the works of the above named authors, in order to show some of the peculiar habits and properties of Fungi, and the conflicting opinions concerning their rank in the scale of being, we do not pretend to decide, even for ourselves, whether they should be treated of as animal or vegetable. And in the use of the term Protophyta, or the name Fungus, we protest against committing ourselves to either view; but, to whatever determination naturalists may in the future be able to bring the dispute, we desire to stand clear of compromise, believing that, whether animal or vegetable, fungi have the faculty of producing the effects, we attribute to them. The only advantage that could accrue to our argument from an

avowed allegiance to the animal doctrine, would be, that these protophyta might then with many medical readers find a readier admittance into their catalogue of human parasites, than if, as at present, fungi were regarded as of a vegetable nature. Since, however, the only scientific ground, on which an objection could be urged against the existence of parasitic vegetables in animal textures, is the general supposition of a necessary similarity in growths which are to share a joint store of aliment, our anxiety in removing that objection is relieved by the knowledge, that, except for a similarity of ultimate composition, no such necessity exists; and the *identity* of ultimate composition has been shown. The existence of vegetable parasites in animals is, however, now a matter of demonstration, having been observed in several instances.

The matter to be adduced in support of the argument will be arranged under five heads or divisions; and we shall endeavour to point out,

1st—The aptitude of Fungi for the habitat, we assign to them as agents in pestilential diseases.

2nd,—Such of the most remarkable among the known effects, produced by organised beings of the order Protophyta (Fungi, Algæ), as are illustrative of our argument.

3rd,—The capability of Fungi to produce the phenomena of pestilential disease, as exhibited in Pestilential Cholera.

4th,—The circumstances which probably concur to produce from the germs of Fungi the effects of pestilential disease,—with facts to prove that a variety of nidus causes a variety of Fungus.

5th,—That the prevention or destruction of Fungous germination, and the consequent catalytic actions, is effected by the very medicinal agents, recommended, on the highest authority, in the Prophylaxis and early curative treatment of Pestilential Cholera.

CHAPTER VII.

APTITUDE OF FUNGI FOR A HABITAT IN THE FLUIDS OF THE HUMAN BODY.

We are first to consider the aptitude of Fungi for the habitat, we assign to them as agents in pestilential diseases. It is generally admitted, that organised beings must find in the substances, to be assimilated in their nutrition, an ultimate composition more or less similar to their own; otherwise the supplied substances would to such beings be altogether void of aliment. And it has been shown that the Protein compounds, from whichever natural kingdom they are derived, are absolutely identical in composition (according to Liebig, even to the fractional parts of mineral matters contained in them), and that they possess the faculty of convertibility in an extraordinary degree; so that any slight disarrangement of the ingredients would easily produce from Albumen Fibrine, or Casein,—and vice versa. And as Fungin so nearly approximates to the Protein compounds in its composition and properties, it too may in all probality belong to them. Then, as these Protein compounds are identical (Liebig) with the albumen

and fibrine of the blood, these would be easily assimilated by beings of a protophytic organisation. That Fungi do grow on dead and decaying animal matter is illustrated in *Onygena Exigua*, peculiar to the nidus of a putrefying hoof of an animal; the advance, therefore, to the consideration of such beings becoming parasitical, or having an existence in *living* substances of animals, would be easy and natural.

But the fact of Fungi vegetating in living animals has, we have said, now been demonstrated. Indeed Dr. Carpenter has supplied us with the particulars of two very interesting instances, in which living animals became the prey of living vegetables, parasitic within their bodies. He writes[1] "Individuals of a species of Polistes (the *wasp* of the West Indians) are often seen flying about with plants of their own length projecting from some part of their surface; the germs of which have been introduced, probably through the breathing pores at their sides, and have taken root in their substance, so as to produce a luxuriant vegetation. In time, however, the fungous growth spreads through the body, and destroys the life of the insect; and it then seems to grow more rapidly,—the decomposing tissue of the dead body being still better adapted than the living structure to afford it nutriment. A still more curious example of this growth has recently been detected; and the know-

[1] 'Principles of General and Comparative Physiology,' p. 73, 74.

ledge of it has proved of much practical importance. The silk-worm breeders of Italy and the South of France, especially in particular districts, have been subjected to considerable loss by a disease called *Muscardine*, which sometimes attacks the caterpillars in large numbers, just when about to enter the chrysalis state. This disease has been ascertained to be due to the growth of a minute fungus, nearly resembling the common mould, within their bodies. It is capable of being communicated to any individual from one already affected, by the introduction, beneath the skin of the former, of some particles of the diseased portion of the latter; and it then spreads in the fatty mass beneath the skin, occasioning the destruction of this tissue which is very important as a reservoir of nutriment to the animal, when it is about to pass into a state of complete inactivity. The Fungus spreads by the extension of its own minute stems and branches; and also by the production of minute germs, which are taken up by the circulating blood, and carried to distant parts of the body. The disease invariably occasions the death of the silk-worm; but it seldom shows itself externally until afterwards, when it rapidly shoots forth from beneath the skin. The caterpillar, chrysalis, and moth, are all susceptible of having the disease communicated to them by the kind of inoculation just described; but it is only the first which usually receives it spontaneously. By a careful investigation of the circum-

stances which favour its propagation, the breeders of silk-worms have been able greatly to diminish the mortality."

Some may be ready to object, that, though it is conceivable, that the existence of a similarly low grade of vitality in the lowest forms of organised beings, animal and vegetable, might admit of such an invasion of the subjects of one kingdom by those of the other, it would be too much to concede, that the highest organisation, as it exists in man, could be so assailed. Nevertheless modern observers have done much to remove such obstacles, as our previous want of knowledge had set up. In the translation of Simon's Animal Chemistry[1] a fungus is described as occurring in pyrosis, and accounts of it have been published from the reports of three different observers; we give the passage,—"[Dr. George Wilson has published a notice of the chemical and microscopical characters of the fluid ejected in pyrosis—the ordinary waterbrash. The most remarkable of these is the appearance of a microscopic cryptogamic plant (sarcina ventriculi), and of acetic, lactic, and carbonic acids in the liquid. The first case, in which these were found, occurred to Mr. Goodsir, and was published by him in the 'Edinburg Medical and Surgical Journal' for April 1842. Since that period a case has occurred in the practice of Mr. Benjamin Bell of Edinburg, who

[1] 'Op. Cit.,' vol. ii., p. 393, et seq.

allowed Mr. Goodsir and Dr. Wilson to examine the fluid ejected by his patient, in which the same organism and acids were discovered; and Mr. Busk, of the Dreadnought hospital ship, Greenwich, has published the history of three cases where the *Sarcina* presented itself, but no analysis was made of the fluids in which it appeared."] A description of the size and form of the Fungus then follows. We find in the same work,[1] that "organisms resembling minute Algæ" were discovered in the product of another disease,—metroperitonitis (puerperal fever)—a disease by the bye often extremely infectious. In this case the cellular bodies, resembling Algæ, were found in the abdominal exudation when examined under the microscope. In 'Braithwaite's Retrospect,' 1846, (v. 14. p. 86) is to be found an account of Confervæ contained in an exudation discharged from the alimentary canal in a dysenteric case, by Dr. J. H. Bennett, who refers to three other authors, who have published accounts referring to similar subjects. I remember to have read, also,—but I have sought in vain for the passage,—of the existence of Oscillatoriæ (Algæ) in the urine. But the most valuable contribution to my collected material on this part of my subject has been made since this division (Part II.) of my little work was prepared for the press. In the 48th No. of the 'British and Foreign Medical Review,' a

[1] Simon, 'Op. Cit.,' vol. ii., p. 499.

Swedish work, by Dr. Berg, on thrush in children was reviewed. We shall have recourse to the review, as it supplies the only part of the work, here of any avail, and also because in employing the original (not yet translated into English) we should require the aid of an interpreter. The 'microscopical character' of Thrush is the chief object for elucidation; and Dr. Berg's description is thus translated by the reviewer:—"The white coating consists of epithelium thickened by the swelling of its constituent cells, and from this epithelium there springs a parasitic fungus in greater or less quantity, so that the chief portion of a patch of aphthæ is composed either of epithelium or else of the parasitic growth. Now, the relative proportions of these two substances seem to depend upon the length of time that has elapsed since the growth of the parasite commenced, which varies in different children, and it is also in relation to the density of the epithelial thickening. More or less of molecular albuminous matter is also to be found in these patches." In another place the 'microscopical character' of the aphthæ is reverted to, thus,—"Under a microscope of the above powers" (200 or 300 diameters), "we find that an aphthous crust consists of epithelial cells, with a more or less interweaved web of fibres, and a variable number of spherical or oval cells, without any sign of exudation corpuscles, but only a small quantity of molecular albuminous deposit. These cells are, with the exception of the nucleus,

everywhere transparent, and have a sharply defined edge, they vary in size according as they are oval, spherical or more prolonged (0·0004—0·0015m., and more). Sometimes they present no nucleus, or an almost imperceptible trace thereof, but the larger ones contain almost always nucleated cellules, sometimes two or even more. These nuclei lie usually in the centre, but very frequently also at the end of the cells. We can often trace the successive development of these cells from a spherical one of the smallest size to an oval cell, and thence to a filament; and we have no doubt ourselves that the smaller cells are sporules, out of whose development the larger oval cells are formed, and finally, the filaments in the same manner as has been observed in other fungoid growths of this nature. The sporules above noticed bear a strong analogy to those of yeast (Torula Cerevisiæ), and this holds good not merely as regards their external form, but likewise in their power of resisting chemical reagents." The qualities which render any part of a mucous membrane a suitable habitat for these parasites are described by Dr. Berg;—in the language of the reviewer we read,—"Aphthous vegetations therefore require to have a firm root among the cells of the epitheluim, before they can vegetate on those surfaces where there is a constant motion of the parts. Consequently the epithelium on which we find numerous ciliæ in constant movement is eminently unfitted for the localisation of aphthæ, nor will the epithelium

which is composed of a single layer of cells be better adapted to this purpose, as the membrane will then be undergoing constant and rapid change. We must therefore conclude that the best *soil* for the growth of aphthous vegetations is undoubtedly that portion of the epithelium where the absence of ciliæ gives full scope to the implantation of sporules, and where several layers of cells afford full room for the spread and interlacing of the vegetable fibres, and where, finally, the membrane being less rapidly changed, due time is allowed for the development of the vegetable growth."

There is, in the extracts from Dr. Berg's volume, so much that is valuable to us in illustrating this division of our argument, that, at the risk of wearying the reader with quotations, we must avail ourselves of the account given of the conditions in which the particular fungoid organism, of which he treats, can exist. Thus we are informed, that—

"1. The aphthous parasite can propagate itself in appropriate menstrua out of the body, and this not only when the aphthous crust is mingled with various animal fluids, but also when completely separated and cleansed from these.

"2. Its growth in such cases proceeds not only in a temperature equal to that of the human body, but likewise in one that is much lower.

"3. Aphthæ seem to require for their growth the presence of a body containing azote, such as albumen,

as also that of the materials for the generation of acid.

"4. Out of the body aphthæ seem to develope themselves in two different forms, either in that of a great preponderance of sporules (sporidier) when a white filmy membrane forms on the surface of the fluid; or, again they appear chiefly as stems ramifying through the fluid, or aggregated into a feltlike mass.

"A solution of potass will always dissolve the molecular deposit of albumen, leaving the fibres and cells of the parasite totally unchanged."

Dr. Berg adopts without reserve the fullest doctrine of contagion in regard to these fungoid aphthous vegetations, believing that dried sporules or portions floating in the atmosphere may impart the consequent disease, Thrush, or that this may be communicated by the sucking bottle; and he succeeded in establishing the contagiousness by actual experiment.

The conclusion from the above facts is irresistible, that there are circumstances under which certain fungoid growths do exist within the human body; nor can it be deemed unphilosophical to suppose that, as the human body does occasionally acquire an aptitude for the existence of protophyta, so, under those conditions of warmth, moisture and electrical constitution of the atmosphere (which ever teems with the sporules of such beings) so well known to assist in the amazingly rapid development

of Fungi, &c.,—conditions well known also to aid in predisposing persons to the attacks of many disorders,—there may be some, who become, by such predisposition, incapable of resisting the intrusion of fungous germs, and in this way aid in their propagation and extensive diffusion, presenting at the same time the attendant morbid phenomena of specific disease. Thence the step to a belief in the origin and communication of pestilential diseases in, and by, sporules of Fungi is easy and natural. We all agree in ascribing to the agency of parasitic animals, certain symptoms of disease exhibited in the human frame; and it would be irrational to deny equal morbific power to parasitic vegetables, when they exist within it.

With the knowledge that the chief characteristic of Protophyta (Lichens, Fungi, Algæ) is the all but incredible power and extent of reproduction by means of sporules, so minute and multitudinous as to pass into the atmosphere by evaporation, as remarked by Fries, possessing an existence almost universal, and penetrating even porous solids, we cannot doubt that, if beings of this order should establish themselves in the blood, and there reproduce themselves, their germs (sporules) would be exhaled in the breath from the pulmonary tissue; and in this way we can trace the probable origin of the contagion of Pestilential Cholera—*if it be contagious.* Lately we might have expected some objector to say, that

the temperature of the blood, or its rapid motion in the vessels, would surely effectually prevent the growth and reproduction of fungi in this fluid; but the facts and experiments made known by Dr. Berg, are sufficient proof that such obstacles are without effect. The growth of some Algæ in rapidly moving water, and the existence of others (Lindley) in hot springs, would, without such evidence, have enabled us to come to the same conclusion.

If beings belonging to the lowest orders of creation, be they vegetable, animal, or neutral, have been found in the abdominal exudation in puerperal fever (a virulently infectious disorder), in the exudation from the alimentary canal in dysenteric disease, in the morbid secretion of pyrosis, in morbid urine, and on the mucous membranes in thrush (fully proved by Dr. Berg's experiments to be contagious), we may judge that their germs had passed through the blood, and hence must have been capable of existing in it. The conclusion, therefore, forces itself upon us, that fungi *may* have their habitat in the blood, which, under favorable circumstances, probably acquires an aptitude for their development in, and propagation from it.

CHAPTER VIII.

ARGUMENT ILLUSTRATED BY KNOWN EFFECTS OF FUNGI.

2nd.—We proceed next to narrate such of the most remarkable known effects produced by organised beings of the order Protophyta, as are illustrative of our argument. Living vegetables are often infested with fungous growths, which, though sometimes found attached to dead or diseased portions, but too frequently attack sound parts. Indeed, whether a moist state of atmosphere with some concurrent electrical condition, stimulating the production of fungi on healthy parts of trees, does not so cause the very diseased state, often found where these organisms vegetate, is a question. It must not be concealed, however, that there is a prevailing disposition to the belief that some degree of decomposition must precede the vegetation of Fungi; a belief in which we cannot concur, and which is opposed to the conclusive experiments of Dr. Berg, in which the aphthous fungi acted on structures of the human body previously healthy, just as any other contagious virus, that usually manifests its effects by means of inoculation, would do. Whether, or not, the decay of living parts of vegetable

matter is attributable to the previous attachment of Fungi,—and there is sufficient support to this view from the phenomena attending mildew and the like,—we are certain that much valuable, and previously sound, timber is destroyed by the ravages within it of a fungoid growth, as Polyporus destructor, Merulius lacrymans and vastator, &c., constituting what is called 'Dry Rot.' Other instances are familiar to us in the common mouldiness of paste, preserves, &c., the ropiness, called 'mother,' of vinegar and ink, and the peculiarly contagious, but more rare, 'ropiness of bread,'—so contagious as to be imparted by shelves, carefully scoured, to successive quantities of loaves laid upon them,—a fact well known to bakers. These are all instances of vegetating fungi, and some of them, we can admit, are of a wonderfully insinuating and penetrating nature. The sourness in these several cases, which soon appears in the various matters becoming mouldy, &c., results from fermentation, originating in the germination of the sporules of fungi. This opinion is well sustained by what is known of the nature and properties of yeast.

The nature of the last named ferment has but recently been discovered; it seems now, however, established beyond a doubt that the active principle in yeast is a vegetating fungus, well described by Dr. Carpenter.[1] "It appears from microscopic examina-

[1] 'Op. Cit.,' p. 74.

tion of a mass of *yeast*, that it consists of a number of minute disconnected vesicles, which closely resemble those of the red snow, and appear to constitute one of the simplest forms of vegetation. These, like seeds, may remain for almost any length of time in an inactive condition without losing their vitality; but when placed in a fluid in which any kind of sugary matter is contained, they commence vegetating actively, provided the temperature is sufficiently high; and they assist in producing that change in the composition of the fluid, which is known under the name of *fermentation*. If a small portion of the fermenting fluid be examined at intervals with a powerful microscope, it is observed that each of the little vesicles at first contained in it, puts forth one or more prolongations or buds, which in time become new vesicles like their parents; these again perform the same process; so that, within a few hours, the single vesicles have developed themselves into rows of four, five, or six. This is not the only way, however, in which they multiply; for sometimes the vesicles are observed to burst, and to emit a number of minute granules, which are the germs of new plants, and which soon develope themselves into additional cells. By the time that five or six vesicles are formed in each group, the fermentation is sufficiently far advanced for the purposes of the brewer; and he then takes measures to check it, by which the vegetation of the yeast is suspended. The groups of vesicles then separate into

individuals resembling those which first constituted the yeast; and thus a greatly increased amount of this substance is the result of this process." In a note to this paragraph, Dr. Carpenter enters into a discussion upon the question of the necessity of these fungi to the process of fermentation; into this we need not follow him further than to his determination of the matter; in which, after stating that saccharine fluids may be changed by various catalytic actions, he adds,[1] "The introduction of the germs of the yeast plant appears to be the most favorable of all conditions; the fermentation which is occasioned by its vegetation being more active and complete than that which can be produced in any other way."

We pass from this account of yeast, an active ferment, by a natural gradation, to make some remarks on fermentation generally. This subject, nearly allied to the question we have in hand, has lately been receiving increased attention, and has excited considerable discussion. The modus operandi of ferments, and the character of the agents whereby fermentation is set on foot, was long wrapt in mystery; but by the discovery of the *torula cerevisiæ* so much light has been thrown upon the matter, that probably ere long the cause and nature of the various kinds of fermentation will become as familiar to us, as the processes themselves are. It is by the action to

[1] 'Op. Cit.,' p. 75, *note*.

which chemists have assigned the name, Catalysis, or decomposition by contact, that changes of various kinds are brought about in organic matter. Thus, in the transformation of barley into malt, during which the barley is stimulated by warmth and moisture to germination, diastase present in the barley becomes an active catalytic agent, and the starch of the seed is by its instrumentality converted into sugar, by which change the malting of the barley is completed. As in the germination of barley, so in that of all other seeds Catalysis takes place. This action is not, however, the exclusive property of organic substances; inorganic matters also possess it in a high degree; and it is remarkable that the catalytic agent usually remains, after perfecting transformations in other bodies, completely unaltered in form, weight, and composition. When a solution of starch at a particular temperature is converted into, first, gum, and second, sugar (of grapes), by the addition of an acid, the latter is found after the operation undiminished and unchanged. It is by this means that the blood is resolved by the several tissues, it is destined to nourish, each tissue appropriating one or more of its constituents to its own nutrition; and in this instance it appears probable, that the porosity or capillarity of the tissues may exercise a powerful catalytic agency,—capillarity being very important, as observed by Dr. Carpenter, "in modifying the

chemical affinity of various bodies for each other." The operation of spongy platinum and porcelain biscuit, in promoting the combination of gases, is a well known instance of the power of capillarity. Just as the germination of seeds is attended by changes effected catalytically, and as the nutrition of the animal tissues is similarly effected, so would the germs of Fungi, introduced into the circulating blood, speedily cause, under favorable conditions, a catalytic action in it, whereby the Fungi would, as in the fermentation by yeast, reproduce themselves at the expence of the vital fluid and all its dependencies. Should it be observed, that in persons affected with Pestilential Cholera the amount of carbonic acid expired is unusually high, as it is in several infectious diseases,[1] the fact would add weight to this argument, even should it not be confirmed by direct microscopic and chemical investigation.

Our information on the subject of ferments in general is still in its infancy; but there seems good ground for believing that they all possess an affinity to that, with the nature and properties of which we are acquainted,—the yeast plant;—in short that they are all organised beings. There is a close analogy in their characters; and they appear to be similarly acted upon by the various agents employed to prevent their effects. Liebig, however, with whom we scarcely dare to differ, pronounces yeast to be a mere chemical

[1] Simon, 'Op. Cit.,' vol. i., p. 127.

compound, void of organisation. His views on the action of yeast and other ferments will be best given in his own words.[1]

"This action may be expressed by the following law, long since proposed by Laplace and Berthollet, although its truth with respect to chemical phenomena has only lately been proved. 'A molecule set in motion by any power can impart its own motion to another molecule with which it may be in contact.'

"This is a law of dynamics, the operation of which is manifest in all cases, in which the resistance (force, affinity, or cohesion) opposed to the motion is not sufficient to overcome it. We have seen that ferment or yeast is a body in the state of decomposition, the atoms of which, consequently, are in a state of motion or transposition, yeast placed in contact with sugar communicates to the elements of that compound the same state, in consequence of which, the constituents of the sugar arrange themselves into new and simpler forms, namely, into alcohol and carbonic acid. In these new compounds the elements are united together by stronger affinities than they were in the sugar, and therefore under the conditions in which they were produced further decomposition is arrested.

"We know, also, that the elements of sugar assume totally different arrangements, when the substances which excite their transposition are in a different state of decomposition from the yeast just mentioned. Thus, when sugar is acted on by rennet

[1] Liebig's 'Organic Chemistry,' edited by Dr. Lyon Playfair.

or putrefying vegetable juices, it is not converted into alcohol and carbonic acid, but into lactic acid, mannite and gum. Again, it has been shewn, that yeast added to a solution of pure sugar gradually disappears, but that when added to vegetable juices which contain gluten as well as sugar, it is reproduced by the decomposition of the former substance.

" The yeast with which these liquids are made to ferment, has itself been originally produced from gluten.

" The conversion of gluten into yeast in these vegetable juices is dependent on the decomposition (fermentation) of sugar; for, when the sugar has completely disappeared, any gluten which may still remain in the liquid, does not suffer change from contact with the newly-deposited yeast, but retains all the characters of gluten.

" Yeast is a product of the decomposition of gluten; but it passes into a second stage of decomposition when in contact with water. On account of its being in this state of further change, yeast excites fermentation in a fresh solution of sugar; and if this second saccharine fluid should contain gluten,—should it be *wort*, for example,—yeast is again generated in consequence of the transposition of the elements of the sugar exciting a similar change in this gluten.

" After this explanation, the idea that yeast produces itself as seeds reproduce seeds, cannot for a moment be entertained."

Some further interesting particulars have been published by M. M. Boutron and Fremy,[1] on the Fermentation of Malt; from which we learn that from one ferment, capable of assuming several forms, we may have as many kinds of fermentation. That in fact the ferment,—the azotised matter in malt "is not one—but a series of ferments." With one more remark on the subject of these ferments we must trouble the reader. The author last quoted proceeds to enumerate several agents by which the processes of fermentation are all prevented, thus, by "the temperature at which water boils, by alcohol," "salts of mercury," "by aromatic substances," "volatile oils," "empyreumatic oil," &c.—Now, had there been up to the present time no actual observation of the growth of Fungi in and upon fermenting substances, we think the two circumstances, of yeast never appearing except in a *decomposing* organic substance (gluten),—and the prevention of the processes of fermentation produced by the action of yeast, or other ferments, by the very substances which check and destroy the growth of Fungi, would have been warrant enough for at least a strong suspicion of the existence of affinity between ferments and Fungi.

Notwithstanding that which to our minds seems so strong an analogy, Professor Liebig maintains the inorganic nature of yeast and other ferments. The

[1] 'Graham's Chemistry,' p. 725.

professor's reasons for rejecting the organic view do not, however, (and it may appear a hardihood of presumption in us to avow it) in the least shake our confidence in the truth of the view we have taken; nor can we find the least difficulty in reconciling the opinion of the organised nature of the yeast cells with the origin from gluten "in the state of decomposition,"—the gluten in such a state having by peculiarity of nidus produced a peculiarity of fungous ferment. Though disposed to join issue with the learned chemist on this one point, we have unexpectedly found much support to our view from some of his opinions; for while he denies a protophytic origin to yeast, &c., he has anticipated, as it were, our view of pestilential diseases being communicated by means of ferments. He instances the fact of placing animal matter, as blood, brain, &c., in a state of decomposition, on wounds, being productive of "vomiting, debility, &c."; and also the case of poisonous enoculation from bodies undergoing dissection. A very remarkable instance of poisonous properties, probably arising from a kind of fermentation, in the german sausages, much employed as food in Wirtemberg, is mentioned by Professor Graham, who writes,[1]—"When these sausages are well prepared, they may be preserved for months, and furnish a nourishing savoury food; but when the spices and

[1] 'Elements of Chemistry,' p. 727.

salt are deficient, and particularly when they are smoked too late or not sufficiently, they undergo a peculiar kind of putrefaction which begins at the centre of the sausage. Without any appreciable escape of gas taking place, they become paler in colour, and more soft and greasy in those parts which have undergone putrefaction, and they are found to contain free lactic acid or lactate of ammonia; products which are universally formed during the putrefaction of animal and vegetable matters.

"The death which is the consequence of poisoning by putrefied sausages succeeds very lingering and remarkable symptoms. There is a gradual wasting of muscular fibre, and of all the constituents of the body similarly composed.

"Sausages, in the state here described exercise an action upon the organism, in consequence of the stomach and other parts with which they come in contact not having the power to arrest their decomposition; and entering the blood in some way or other, while still possessing their whole power, they impart their peculiar action to the constituents of that fluid."

How easy and simple is the explanation of these phenomena, on the hypothesis of the change in the sausage, and subsequently that in the human blood, having been produced by the agency of Fungous germs, resembling the *torula cerevisiæ*; and how natural a link does this instance afford us in the chain

of argument, by which we design to prove, that an identity is to be found between the virus of Pestilential Cholera and some low protophytic (fungous) organisation. It is worthy of our attention that the presence of fungi in the secretion in pyrosis, in the abdominal exudation in metroperitonitis, &c., on the mucous membrane of the alimentary canal in aphthæ, *were all accompanied by the production of lactic or acetic acid,* just as is found in the fermented sausage, and in matters undergoing the viscous fermentation. The vomited matters in Pestilential Cholera contain much free acid (acetic or lactic). But such discrepancies in the opinions of even scientific men, as we here find between Dr. Carpenter's description (from ocular demonstration—not argument) and Professor Liebig's induction, only add force to the remark that "all do not see the same objects through the same optics"; but we have our chemical spectacles, our physiological spectacles, &c., the peculiar powers of one or other suiting peculiarities to be found in the visual faculties (mental) of most scientific investigators. For our own part we do not care, whether the agents in these operations are to be regarded as vegetable, animal, or neutral; but we contend, that the phenomena can only be explained on the supposition of their being *organised.*

To recapitulate,—it has been shown in this section that the infinitely minute germs (sporules) of Fungi,—ever present in the air we breath, and as it were

seeking an opportunity,—in the very first tendencies to decomposition of organised matter, vegetable or animal, dead or alive,—to germinate and reproduce themselves, though in forms ever varying with peculiarities of nidus and aliment,—do by their germination effect changes and transformations only recently discovered to be ascribable to such agency,—dry-rot, smut, rust, ergot, mildew, mould, &c. That processes (the various kinds of fermentation), hitherto regarded as purely chemical and inorganic, may with much probability be assigned to the province within which fungous germination pursues its avocation; and, in fact, that in one of such processes the germination and reproduction of Fungi has been demonstrated, as the acting cause. This view, moreover, so well harmonises with what is known of the modes by which the Protophyta (Fungi, &c.) propagate themselves; and the circumstances,—preventive and promotive,—in both cases so nearly correspond, that the inference of *Identity in Generic Properties*, appears to us nearly to approach demonstration.

CHAPTER IX.

CAPABILITY OF FUNGI TO PRODUCE THE PHENOMENA OF PESTILENTIAL CHOLERA.

3rdly,—In passing to the consideration of the third head of our argument, viz., "The capability of Fungi to produce the phenomena of pestilential disease, as exhibited in Pestilential Cholera," we have to premise, that, notwithstanding the great extension of our knowledge of pathology, by means of the microscope and chemical analysis, there is still very much concealed from our view. Indeed, in regard to the disease we are considering, the microscope appears to have, hitherto, been put much less into requisition, than the retort and test tube. Should it be decreed that another visitation of this pestilence shall speedily be announced in this country, we do, however, trust that the joint labours of those, who are severally skilful in the use of the one, or other, of these valuable instruments in exploring the depths of medical science, will effectually dispel the obscurities that at present becloud us on this subject. Neither

one, nor the other, is sufficient to undertake the task singlehanded. The numerous facts, brought forward under the last division, by showing in how many processes Fungi have been the hitherto unsuspected agents, taken together with the accounts given, in the first division, of these low organisms being also active in the production of disease, will prepare the mind of the reader to give a readier reception to the view, for which, in this third division, it will be more peculiarly our business to supply credentials. It will not be expected, that we should be able from merely analogical proofs to supply the minutiæ, by which the doctrine of a fungous origin of Pestilential Cholera would be perfectly explanatory of all the known symptoms and appearances of that disease;—the complications of which—secondary results only of the fungous germination—will, after a brief existence of the disorder, cast into shadow the primary manifestations of its protophytic origin. The adjustment of details and circumstantials will be accomplished, it is hoped,—in the event of further opportunities being afforded,—by the many able and diligent students of this deeply interesting question.

It is desirable, that just notions of the method, by which the several tissues are built up, should be entertained, in order to comprehend clearly the extreme simplicity of the process of nutrition, carried on on one type or plan in all grades of organised beings. The operation of catalysis, already described,

should be borne in mind, while we proceed to quote from M. Simon [1] an account of the above process.

"We know, from the investigations of Schwann and Reichert, that all the tissues of the animal body are composed of cells, and that nutrition and growth of the organs and tissues is conducted by the production of new cells, appropriate for each individual organ, developing themselves at every point where the substance from which they are formed, viz., the blood, is conveyed; that these cells, by their organic formation, effect a change in the nutritious plasma, by appropriating from it matters homologous to themselves, and that the cells are finally consumed or dissolved, as is obvious from the general phenomena of the circulation. The nutrition and consumption of the tissues of the animal body in the general process of life is, consequently, the product of the nutrition and consumption of the cells which constitute those tissues. Since the capillaries are distributed over every particle of each individual tissue, and since their walls are composed of cells, which can communicate and impart the plasma to the adjacent cells, the plasma can be universally distributed, and the reciprocal action between it and the cells of the various organs ensured.

"In what manner the cells act upon the nutrient fluid we are not able to understand, but there can

[1] 'Op. Cit.,' vol. i., p. 1 0.

be little doubt that they or (which amounts to the same thing) the organs and tissues which they constitute, produce a dialytic, catalytic, or, as Schwann terms it, a metabolic change on the plasma of the blood. The products of these influences must necessarily consist of certain chemical compounds, formed in very different ways, and varying in their nature in accordance with the activity of the nervous power. The high atomic numbers of those animal substances which are of the most importance in nutrition, as the protein-compounds and fats, render the existence of numerous decompositions extremely probable. In vegetable chemistry we find whole classes of substances transmutable, one into the other, in which the same radical, consisting of carbon and hydrogen, is combined with different atoms of water, or of water and oxygen; I need only refer to woody fibre, starch, gum, sugar, and lactic acid. We have sufficient grounds for assuming the existence of similar radicals in the chemical compounds of the animal body; and if we knew more of the composition of the extractive matters, we should doubtless find a radical common to all of them. In many of these decompositions, which are extremely varying in their nature, oxygen is undoubtedly absorbed, and carbonic acid evolved, as indeed we see in the process of respiration."

This doctrine of cellular development is now applied to the explanation of the process of growth

in all the organised beings in creation, to whatever degree of complication they may be severally advanced in their maturity. Cells, developing germs of cells either within themselves, or on their exterior surface, exactly as described in the microscopic examination of the yeast plant, constitute every known living structure in its earliest stage of formation. This resemblance in the mode of origin of organised structures in the highest and lowest grades of existence, with the identity in ultimate composition of the Protein compounds which form the foundation of every organic substance, will serve to diminish in our minds any exaggerated ideas of distinction between our own textures, and those of a mushroom or a polype; and will tend also to procure admission for the belief that our doctrine is by no means as irrational, as, if propounded without proof, it might have appeared.

We repeat, then, in the form of question, why may not the germs of a Fungus or Alga be absorbed into the blood, and be so absorbed at a time when an extraordinary impulse has been communicated by external concurring conditions, probably meteorological,—the blood, meanwhile, being in such a bio-chemical condition, as to be able to oppose but little vital resistance to the reproduction of Fungi within it? And, as it has been shown that these *can* live and grow within the human body, and in the

fluids of it, we may naturally expect to find some of the effects, described as fermentations, taking place within the blood itself? The blood contains principles eminently qualified for the conduct of such processes, and might, we presume, take on either a viscous or a putrefactive process of fermentation: nay, we affirm it as our belief, that one pestilence may be characterised by symptoms originating in one of these forms, while another shall present manifestations, dependent on the other kind, of fermentation. We have reserved Professor Graham's Account of the 'lactic or viscous fermentation' for this place: it is as follows:[1]

"At a temperature between 86° and 104,° the saccharine juices of plants containing albumen or other azotised matter, undergo a species of fermentation, which is different from the vinous, combustible gases being evolved with carbonic acid, and a gummy matter formed, having the composition of gum arabic, which renders the liquid ropy and thick, and hence the application of the name viscous to this fermentation."

"M. M. Boutron and Fremy have lately observed that the formation of lactic acid precedes that of the other products, and that it may be produced alone, without the evolution of any gas or formation of mannite. Diastase and caseum, after they have undergone a modification by a few day's exposure, in

[1] Graham, 'Op. Cit.,' p. 808.

a humid state, to air, are of all organic matters containing nitrogen the most efficient in determining the lactic fermentation. Air does not interfere by its elements, unless in transforming the animal matter into the lactic ferment."

Thus, according to Boutron and Fremy, *after exposure in a moist state to the air*, Diastase and Casein acquire the properties of lactic ferments. Now we have seen that after exposure to similar causes of decomposition gluten acquired the properties of a ferment likewise; and, as we know that in the latter case a fungus was the agent developed in the decaying gluten, we infer that in this instance of decaying casein or diastase, a fungous development also took place. Again, we have in Fungin an azotised substance well adapted, even according to the chemical theory, to act as a ferment; so that in whichever way the change, we are supposing to occur in the blood, may be educed, this substance may be the etiological agent in Pestilential Cholera.

Medical men are for the most part agreed that in Pestilential Cholera, as in other pestilential diseases, the first impression by the materies morbi is made on the blood; all the subsequent symptoms in that disease are, moreover, plainly referrible to an altered condition of that fluid. Indeed it would appear as if a diseased process analogous to that of gangrene in the solids were set up in the blood. By the word gangrene, we wish not to be understood, as implying

absolute death,—mortification (sphacelus), but, as we find warrant in surgical works, we desire "to restrict the term gangrene to the state which precedes, and commonly (but not inevitably) terminates in sphacelus; a state in which, as Thomson says 'there is a diminution, but not a total destruction, of the powers of life;—in which the blood appears to circulate through the larger vessels; in which the nerves still retain a portion of their sensibility, and in which perhaps the part may still be supposed to be capable of recovery.'" In the disease, which, from the name of its imputed cause, has been called Ergotism, we have symptoms allied to those constituting Pestilential Cholera, while they at the same time, point significantly to a gangrenoid state of the blood, as the first morbid condition; and we have a further alliance, indicated by the knowledge that the cause of Ergotism originates in a fungoid growth, while we conclude that the Pestilential Cholera thus originates likewise. Let us here dwell somewhat at length on the subject of the disease, denominated Ergotism; but first let us enumerate the symptoms which follow poisoning with Fungi generally,—symptoms which it will be seen lend their help also towards establishing by their analogy our present argument.

Drs. Christison and Pereira agree in their accounts of the poisonous effects produced by deleterious fungi. Dr. Pereira says (vol. ii., p. 574), "The symptoms produced by poisonous fungi are those indicating

gastro-intestinal irritation (nausea, vomiting, purging, and abdominal pain), and a disordered condition of the nervous system (delirium, stupor, blindness, convulsions, muscular debility, paralysis, drowsiness). In some cases, the power of the vascular system is remarkably depressed, the pulse being small and feeble, the extremities cold, and the body covered with a cold sweat. At one time, local irritation only; at another, narcotism alone is produced." (For illustrations of the effects of particular species, see p. 15 of this work, and consult Phœbus, 'Deutschl. Kryptog. Giftgewächse,' 1838; and Letellier, 'Journ. de Pharm.' Août. 1837.) Dr. Christison enters at considerable length into a detail of the cases of poisoning by fungi, illustrating in several instances the narcotic and the acrid effects produced separately, or conjointly, in the sufferers; and he adds another kind, of which he says,—"It is likewise not improbable, that fungi, even though not belonging to the varieties commonly acknowledged as poisonous, induce, when taken for a considerable length of time, a peculiar depraved state of the constitution, leading to external suppuration and gangrene." "Several French soldiers, in Russia, ate a large quantity of the *amanita muscaria*, which they had mistaken for the *amanita cæsarea*. * * The pulse became small and irregular, and the body bedewed with a cold sweat; the lineaments of the countenance were singularly changed, the nose and lips acquiring a

violet tint; they trembled much; the belly swelled, and a profuse fœtid diarrhæa supervened. The extremities soon became livid and cold, and the pain of the abdomen intense; delirium ensued; and all the four died." "A man, his wife, and three children, eat to dinner carp which had been stewed by mistake with the *amanita citrina*. The wife, the servant, and one of the children had vomiting, followed by deep sopor; but they recovered. The husband had true and violent Cholera, but recovered also. The two other children became profoundly lethargic and comatose; emetics had no effect, and death soon ensued without any other remarkable symptom." "The last set of cases to be mentioned were produced by the *Hypophyllum sanguineum*, a small, conical fungus, of a mouse colour, that grows on a slender stem, and is well known to children in Scotland by the name of *puddock-stool*. This species seems to cause convulsions as well as sopor. A family of six persons, four of whom were children, ate about two pounds of it dressed with butter. The incipient symptoms were pain in the pit of the stomach, a sense of impending suffocation, and violent efforts to vomit; which symptoms did not commence in any of them till about twelve hours after the poisonous meal; in one not till twenty hours, and in another not till nearly thirty hours." "The mother had frequent bloody stools and vomiting; the skin became yellow; the muscles of the abdomen were contracted spasmodically, so that the navel was

drawn towards the spine, profound lethargy and general coldness supervened; and she, too, died about thirty-six hours after eating the fungus. * * * "The father had a severe attack of dysentery for three days, and remained five days speechless. For a long time afterwards he had occasional bloody diarrhæa. He eventually recovered; but even for an entire year his health continued to suffer." "A striking circumstance in respect to the symptoms of poisoning with the fungi, is the great difference in the interval which elapses between the time of eating and that of their commencement. In the first case, the symptoms appear to have commenced in a few minutes; but, on the contrary, an interval of twelve hours is common; and *Gmelin* has quoted a set of cases, seventeen in number, in which the interval is said to have been a day and a half." The following account from 'Rust's Journal' also appears amongst these cases in Dr. Christison's work. "A family, consisting of the mother and four children, were seized with a kind of tertian fever, and an eruption, on various parts of the body, of abscesses discharging a thin ill-conditioned pus, which passed rapidly into spreading gangrene, and proved fatal to the mother and one of the children. No other cause could be discovered to account for so extraordinary a conjunction of symptoms in so many individuals, except that for two months they had lived almost entirely on mushrooms; and the probability of this being really

the cause was much strengthened by the fact, that the father, who slept always with his family, and who alone escaped, lived on ordinary food at a place where he worked not far off."

Of some of the *Morbid Appearances*, presented after death by poisonous Fungi, the following are mentioned in the account given by Dr. Christison :—

" The body is in general very livid ; and the blood fluid." " The lungs have sometimes been found gorged or even inflamed."

Such is the narration of the effects of poisoning with Fungi of various kinds,—varieties of morbid phenomena resulting in the several members of one family poisoned with the same variety of Fungus. There is a manifest similitude in some of the cases of poisoning with Fungi with cases of Pestilential Cholera ;—The oppression and anxiety, the lividity and coldness, the thready pulse and cold sweat, and the spasms, as well as the ejections by vomiting and purging, witnessed in the several instances, and all combined in some, attest the fact. Nor can any peculiar principle be found, according to M. M. Braconnot and Lettellier, to which the poisonous properties can with sufficient reason be assigned. We believe that much of the malignancy of these poisonous agents is, like the malignancy of Cancer, to be ascribed, as is done in the latter instance by some able authors, to their vast and unrestrainable powers of reproduction. The symptoms merely of Pestilential Cholera are well

represented by this class of cases; but the phenomenon of infection, or contagion (words employed in this work synonymously), is here not exhibited.

We pass on now to notice the peculiar disease, Ergotism or 'creeping sickness,' first however giving some account of its generator, Ergot or spurred Rye. After long disputation as to the real cause of Ergot, this has now been demonstrated to us as a fungus, named by the late Mr. Quekett, Ergotætia Abortifaciens, and the parasitic animal, found on spurred rye and by some reported to be its producer, is now discovered to be an acarus which merely feeds on the excrescence. A minutely detailed discussion of the whole question is given by Dr. Pereira, to whose work we must refer the reader for fuller information, not having space for more than the deduction to which he has arrived.[1] "The statement of Leveillé Phillipar ('Traité Organogr. et Phys.-Agr. sur la Carie, le Charbon, l'Ergot, &c., 8vo. Versailles, 1837), Smith and Quekett, leave, I think, but little doubt that Ergot is a disease of the grain caused by the presence of a parasitical fungus. This view is supported by the observations of Wiggers,—that the white dust (*sporidia*, Quek.) found on the surface of Ergot will produce the disease in any plant (grass?) if sprinkled in the soil at its roots."

[Fontana is related by Christison to have alleged a similar result from his experiments.

[1] Mat. Medica, pt. ii., p. 572 and p. 595, et seqq.

Collateral testimony to the practicability of this is to be found in the work of Dr. Carpenter so often referred to; he says,[1] "That *entophytic* Fungi may be communicated from one plant to another, has been fully ascertained by the experiments of Decandolle and others. It is usually imagined that the germs liberated by one plant are taken up by the roots of others, and being carried along the current of sap, are deposited and developed in the parts where vegetation is most active; perhaps, however, they may find a shorter entrance into the cavities of the fabric, by means of the stomata, these being the precise situations where they are subsequently manifested."]

"Phœbus ('op. cit.' p. 104) who has most accurately depicted these sporidia, denies that they are spores, on the ground that they are of variable size, and enclose other smaller bodies. But these objections deserve no attention, for, in the first place, by calling these bodies sporidia, we avoid deciding whether they are sporangia or spori; and, secondly, the sporidia of other plants of the fungic nature, of which botanists entertain no doubt, also enclose smaller bodies (sporidiola, Berk. &c. &c.).

"Mr. Quekett, who has most carefully examined the development of ergot, says, that the first appearance of ergot is observed by the young grain and its appendages becoming covered with a white coating,

[1] 'Op. Cit.,' p. 73.

composed of multitudes of sporidia (fig. 76, A. p. 572) mixed with minute cobweb-like filaments (Ergotætia Abortifaciens, see p. 572, fig. 76, H. I.). This coating extends over all the parts of the grain, cements the anthers and stigmas together, and gives the whole a mildewed appearance. When the grain is immersed in water, the sporidia fall to the bottom of the liquid. A sweet fluid, at first limpid, afterwards viscid is found in the affected flower at this stage; and, when examined by the microscope, is found to contain the sporidia just referred to (Phillipar, Smith, and Quekett). Phillipar (op. cit. p. 111) says this fluid oozes from the floral centre; but Mr. Quekett thinks that it may have an external origin, and be in fact water (dew or rain) charged with sporidia; though Phœbus had previously observed that this source was very improbable." In the following analysis of Ergot, taken from Dr. Pereira's work, (p. 599, pt. ii.), we see that the fungous nature of ergot is well supported; and that besides the fungin, which is the predominant ingredient, there is a large proportion of fixed oil. We give only one of the two analyses, as they do not differ in any material point; and that of Wiggers is more minute than that supplied by Vauquelin, as well as having been made more recently by many years. The analysis of Chevalier, we are informed, was in its results analogous to that of Wiggers, which was made in 1831.

Wiggers' Analysis.

Ergotin	1.25
Peculiar fixed oil	35.00
White crystallizable fat	1.05
Cerin	0.76
Fungin	46.19
Vegetable osmazome	7.76
Peculiar saccharine matter	1.55
Gummy extractive with red colouring matter	2.33
Albumen	1.46
Superphosphate of Potash	4.42
Phosphate of lime with trace of iron	0.29
Silica	0.14
	102.20

We return to the work of Dr. Christison[1] for an account of the "*Effects of Spurred Rye on Man and Animals.* Before proceeding to relate the effects of this poison on man, it should be mentioned, that at different times doubts have been entertained, whether the baneful effects ascribed to it did not really arise from some other cause. But, independently of the connexion which has been frequently traced between the poison and the diseases imputed to it in the human subject, the question has been set completely at rest by the experiments which have been tried on animals, and which indeed were instituted with a view to settle the point in dispute.

[1] Treatise on Poisons.

"The experiments hitherto made on animals are not so complete as could be wished. But they are nevertheless sufficient to show that spurred rye is an active poison of a very peculiar kind. According to the observations collected by *Dr. Robert* from a variety of authors, it follows, that it is injurious and even fatal to all animals which are fed for a sufficient length of time with a moderate proportion of it, unless they escape its action by an early vomiting;—that dogs and cats, in consequence of discharging it by vomiting, suffer only slight symptoms of irritant poisoning;—but that swine, moles, geese, ducks, fowls, quails, sparrows, as well as leeches and flies, are sooner or later killed by it;—and that the symptoms it causes in beasts and birds are in the first instance giddiness, dilated pupil, and palsy, and afterwards diarrhæa, suppurating tumours, scattered gangrene throughout the body, and sometimes dropping off of the toes."

"The affection produced differs much in different epidemics and even in different cases of the same epidemic. Two distinct sets of symptoms have been noticed; the one constituting a nervous disease which is characterized by violent spasmodic convulsions, the other being a depraved state of the constitution, which ends in that remarkable disorder, dry gangrene; and it does not appear that the two affections are apt to be blended together in the same case.

"These extraordinary and formidable distempers were first referred to the operation of spurred rye in

1597 by the Marburg Medical Faculty, who witnessed the ravages of the poison in Hessia during the preceding year. Since then repeated epidemics have broken out in Germany, Bohemia, Holstein, Denmark, Sweden, Lombardy, Switzerland, and France."

Besides the disease here described as Ergotism, symptoms of a peculiar kind have not unfrequently been observed to follow the medicinal use of Ergot. Thus the pulse has been in some cases greatly reduced in force and frequency (Cusack, Maunsell,); lividity of the face was also seen by the above-named physicians as a result of the employment of this medicine; and nausea and vomiting with various other symptoms have occasionly occurred under its administration. In Mr. Quekett's experiment of inoculating healthy plants with the sporidia of *Ergotætia* we have an instance of contagion; while in the viscous exudation from the flower we have perhaps a phenomenon representing the viscosity of the peritoneum, or the albuminous exudation on the mucous membrane of the alimentary canal found in Pestilential Cholera, the latter probably corresponding also in nature, and in similitude of cause, to the albuminous aphthous crusts constituting Thrush. In Wiggers' analysis of the excrescence of Ergot, the undoubted product of a fungous growth, we have seen that there was a large proportion of fixed oil; in the account of a disease arising in Wirtemberg from sausages, which had passed through a peculiar process of fermentation,

we have read (p. 138,) that the *increased greasiness* was one of the most remarkable of the visible alterations, which had taken place in this article of food,—while the consequent "gradual wasting of the muscular fibre and of all the constituents of the body similarly composed," may be almost paraphrased by Dr. Christison's description of similar symptoms in gangrenous Ergotism, "finally the affected parts, and in the first instance the fingers and arms, afterwards the toes and legs, shrivelled, dried up, &c." In some infectious diseases oiliness of the blood has been commonly remarked, as in plague (Simon), typhus, and Pestilential Cholera (Copland, art. Pest. Chol. sec. 43). An abundance of fat has also been found in the fæces, discharged in abdominal typhus. M. Simon says[1] "sometimes we find" (in abdominal typhus) "as also in phthisis intestinalis, small white masses about the size of a millet, or half as large as a hempseed; they are easily triturated and then have a greasy appearance; when examined under the microscope they appear to be composed of cells, similar to primary cells, or what are called the globules of inflammation. The contents of these sperical cells, which are enclosed in a very delicate membrane, are coarsely granulated and escape on the least pressure.

"In some of the larger parent cells, I found smaller cells with nuclei."

[1] 'Op. Cit.,' vol. ii., p. 381.

Before we quit the subject of Ergotism, we cannot refrain from one recommendation of a practical kind, in regard to the administration of Ergot as a medicine. So far as experiments have been able to determine the properties of the several principles presented to our notice in the analysis of Ergot, there appears sufficient reason to attribute the phenomena of Ergotism to the fixed oil (Dr. Charles Hooker of Connecticut), and the Ergotin; while Dr. Pereira thinks that the influence of the medicine over the uterus probably depends on the vegetable osmazome. Should these inferences become established, valuable indications as to the mode of employing Ergot as a medicinal agent (by separation of its principles), may be derived from them. Again, on the supposition that Ergotism is effected by the agency of Fungous germination, we have only to employ some of the agents capable of destroying its germinating power, in order to deprive the medicine of its deleterious properties in this respect, a check being thereby put to the reproduction of the principles that might proceed to cause the state referred to,—Ergotism. While, if the antihæmorrhagic virtues of the medicine are in requisition, inasmuch as these depend on the same properties of the drug, as are productive of the diseased condition above alluded to, the retention of these must be secured by avoiding all combinations or methods of preparation, by which the reproductive powers of the Fungus would be destroyed. In a word, to produce

uterine contraction an infusion made with boiling water, or a tincture prepared with alcohol, may be employed in combination with aromatics, if desired; but, on the other hand, if the medicine is indicated to check hæmorrhage of a passive kind (as we have seen in pulmonary hæmorrhage which was controlled by this medicine) heat, alcohol, metallic salts, and aromatics, should be avoided in dispensing it.

After this digression, we return to the subject of the properties of Fungi, and shall conclude this division with an account of a Fungus, possessed of peculiar properties of a contagious nature, though not causing an epidemic. Professor Lindley speaking of *Amanita muscaria*, says,[1] "This variety of Amanita Muscaria is used by the inhabitants of the north-eastern parts of Asia in the same manner as wine, brandy, arrack, opium, &c., is by other nations. These Fungi are found most plentifully about Wischna, Kamchatka, and Wilkowa Derecona, and are very abundant in some seasons, and scarce in others. They are collected in the hottest months, and hung up by a string in the air to dry: some dry of themselves on the ground, and are said to be far more narcotic than those artificially preserved. Small deep-coloured specimens, thickly covered with warts, are also said to be more powerful than those of a larger size and paler colour. The usual mode of

[1] 'Introduction to Natural System,' p. 337.

taking the Fungus is, to roll it up like a bolus, and swallow it without chewing, which the Kamchatkadales say, would disorder the stomach. It is sometimes eaten fresh in soups and sauces, and then looses much of its intoxicating property; when steeped in the juice of the berries of vaccinium uliginosum, its effects are those of strong wine. One large, or two small fungi, is a common dose to produce a pleasant intoxication for a whole day, particularly if water be drank after it, which augments the narcotic principle. The desired effect comes on from one to two hours after taking the fungus. Giddiness and drunkenness result in the same manner as from wine or spirits; cheerful emotions of the mind are first produced; the countenance becomes flushed; involuntary words and actions follow, and sometimes at last an entire loss of consciousness. It renders some remarkably active, and proves highly stimulant to muscular exertion: by too large a dose, violent spasmodic effects are produced. So very exciting to the nervous system, in many individuals, is this fungus, that the effects are often very ludicrous. If a person under its influence wishes to step over a straw or small stick, he takes a stride or a jump sufficient to clear the trunk of a tree; a talkative person cannot keep silence or secrets; and one fond of music is perpetually singing. The most singular effect of the amanita is the influence it possesses over the urine. It is said that, from time immemorial, the inhabitants

have known that the fungus imparts an intoxicating quality to that secretion, which continues for a considerable time after taking it. For instance, a man moderately intoxicated to-day will, by the next morning, have slept himself sober, but (as is the custom) by taking a teacup of his urine he will be more powerfully intoxicated than he was on the preceding day. It is, therefore, not uncommon for confirmed drunkards to preserve their urine as a precious liqnor against a scarcity of the fungus. This intoxicating property of the urine is capable of being propagated; for every one who partakes of it has his urine similarly affected. Thus, with a very few amanitæ, a party of drunkards may keep up their debauch for a week. Dr. Langsdorf mentions, that by means of the second person taking the urine of the first, the third that of the second, and so on, the intoxication may be propagated through five individuals." In this curious narrative of the addiction of certain of our Asiatic brethren to the vice of intemperance, the fascination of luxurious beverages, so vainly pleaded amongst ourselves in mitigation of the fault, cannot at any rate be urged on their behalf. Indeed the habit, always sufficiently disgusting, is so both in cause and effect in this instance: spite of which the account is not without interest to investigators of medical science. To us it is peculiarly valuable, as supplying another link to our chain of analogical reasoning on the identity of the morbific virus of Pestilential Cholera with some of

the lowest forms of organic existence. The effects of *Amanita muscaria*, propagated in the manner described, resemble what we are led to believe takes place in a somewhat different way from other human fluids in the production of infectious diseases; i. e., we regard the communication—the contagiousness—in the one case of intoxication by amanita, as in the other of the phenomena of Pestilential Cholera, whether contagious or not, to originate in the germs of a fungus.

Our induction from the facts, detailed in this branch of our enquiry, is, that they prove "the capability of fungi to produce the phenomena of Pestilential disease, as exhibited in Pestilential Cholera." The facts we will here recapitulate;—it has been shown that the tissues of all bodies are alike nourished by the growth of cells, whether these are to form the highest or the lowest organisation,—a man, or a mushroom;—that in the lactic or viscous fermentation we have appearances and products, which much resemble what is found, after Pestilential Cholera, in the blood and secretions, as also in some of the tissues;—that the state of the blood in Cholera may be regarded as representing the first stage of mortification (gangrene) of solids;—that several fungi produce poisonous effects, closely imitating the symptoms of Pestilential Cholera;—and that from the extensive mixture of one of these beings in food there results an epidemic disorder, affecting the inhabitants of whole countries

on the continent;—and that, in such epidemic, gangrene and wasting of the solids are the pathognomonic distinctions of one of its forms, nearly resembling a disease common in Wirtemberg from the use of bad sausages;—and that a peculiarity which exists both in the composition of the fungus, producing ergotism on the one hand, and in the deleterious sausage on the other, is a remarkable abundance of oily matter,—a characteristic also of the blood, in which we suppose like organisms to have germinated. Lastly, that very remarkable effects are attributed to one species, the *Amanita muscaria*,—effects partaking of the nature of contagious communication.

CHAPTER X.

CIRCUMSTANCES CONCURRING TO PRODUCE PESTILENTIAL DISEASE FROM FUNGI.—FUNGI VARY WITH THEIR NIDUS.

4th.—In the fourth division of the argument we propose to show "the circumstances which probably concur to produce from the germs of Fungi the effects of pestilential disease,—with facts to prove that a variety of nidus causes a variety of Fungus."

In Dr. Lindley's description of the character and habits of Fungi, it will be remembered, it is stated, that they "are frequently meteoric, that is, spring up after storms, or only in particular states of the atmosphere" (quoted at p. 107). A reference to the histories of Pestilences, whether these are the visitations of ancient or modern times, shows a remarkable agreement in all the writers of them, as to the fact of the prevalence of remarkable meteorological changes and other phenomena, preceding or accompanying the outbreak of these plagues. Thus Hecker in detailing the history of a very destructive epidemic which swept away incredible numbers in China in the 14th century, mentions, that the disorder followed in

the wake of volcanic and meteoric disturbances of a very violent kind. Similar phenomena have in modern times, and in all intermediate periods, been observed to prevail about the beginning of our severest plagues; and Dr. Holland has made especial remark of atmospheric or meteorological peculiarities, manifested in connection with the epidemic Influenzas, to which we have been subject of late years. On the occasion of a sudden appearance of Pestilential Cholera in Scinde, in 1846, we read from the 'Bombay Times,'—"The heat had for the first fortnight in June been intense, but there was no considerable amount of sickness at the station. The 14th was a Sunday, and the atmosphere was more than usually stagnant and oppressive. *A thick portentous looking cloud* crept up the sky when the troops were proceeding to church, and a sudden burst of wind threatened the buildings. It passed away almost as speedily as it came, and when the worshippers retired the air was as still as when they assembled. *At that same hour did the Pestilence appear.* Before midnight nine of the 86th were at rest, and men began to be borne into hospital in such numbers, that it was difficult to make arrangements for their reception." The above extract depicts the peculiarly striking meteorological accompaniment of the approaching Pestilence, as seen at Kurrachee in Scinde, in June 1846, where, in the space of a fortnight, 900 Europeans, 600 native soldiers, and

7,000 camp followers were hurried by it into eternity. We shall shortly have occasion to point to some topographical peculiarities of the locality, where this occurred.

Within a few years the science of Electricity has by the ingenious labours of Faraday and others made such amazing advancement, that perhaps the most enthusiastic and imaginative can scarcely anticipate the vast acquisitions to science, in all its departments, to be ere long achieved by its alike all-present and all-powerful agency. That it is a principal performer in all chemical and vital attractions no longer needs demonstration. In its effects we see it regulating the orderly arrangements and forms of life, or, by its excessive accumulation and discharge, disturbing or destroying its own previous arrangements, and the forms dependent upon it. All bodies are ranged in two distinct divisions, characterised by their different electrical conditions,—positive or negative. Among our chemical re-agents, acids are to be found in the negative class, and alkalies in that which is positive. Again, the various vegetable powders or farinæ are distinguishable in some instances by their several electrical properties; so much so, that it was not long since proposed to apply this distinctive test to the discovery of adulterations of arrowroot, &c. And, indeed, most of our readers may probably recollect an experiment, familiar in the chemical lecture-rooms of the metropolis, in which a vegetable powder (and

it so happens that it was the dust,—sporidia of *lycoperdon*, which *we* saw employed for the purpose), on being dusted, by means of a flour-dredger, over a blackened board on which some characters had been traced with a magnet (if we remember rightly), was found, when an attempt was made to blow it away, to leave the whole surface of the board, with the exception of the parts previously touched with the magnet,—to these the powder was adherent. This little experiment will serve to illustrate the author's views of the manner in which the germs of fungi gain admittance into the blood of some persons, while their entrance is in others successfully resisted.

Careful experiments have been conducted in order to ascertain the electrical states of different persons, and, whether in any one person this condition varies, or not, with alteration of circumstances; and what relations such variations bear to each other. The investigators of these matters had to encounter many difficulties; but, spite of these, their labours have been rewarded with the discovery of some important particulars, which form very welcome additions to our limited knowledge of this subject. It appears to be by no means improbable, that, besides the identity, now admitted to exist, between chemical affinity and electrical affinity or attraction, a similar identity is also to be found between the latter, in a modified state, and the vital affinities and attractions, whereby nutrition and other vital functions are conducted; an

approach to such a conclusion has already been established. Much interesting information on the manifestations of electricity is to be found in Dr. Carpenter's 'General and Comparative Physiology,' to which we must refer the reader for fuller particulars, while we extract only so much as is required by our present argument. In animals,[1] "Donné found that the skin and most of the internal membranes are in opposite electrical states; and Matteuci has seen a deviation of the needle amounting to 15° or 20°, when the liver and stomach of a rabbit were connected with the platinum ends of the wires of a delicate galvanometer. It may be questioned whether or not the differences in the secretions of these parts were the cause or the effects of their electric conditions. According to Matteuci, it could not be by their chemical action on the wires that the manifestation was produced, since it became very feeble, or entirely ceased on the death of the animal. These experiments are confirmation, as far as they go, of Dr. Wollaston's theory respecting secretion. Observing the connection between electricity and chemical action, he was led to think, that all the secretions in the body are the effect of electrical agency acting in various modes; and that the qualities of each secretion point out what species of electricity preponderated in the organ which forms it. Thus, the existence of free acid in the urine and

[1] Carpenter, 'Op. Cit.,' p. 433.

gastric juice, and of free alkali in the bile and saliva, mark the prevalence of positive electricity in the kidneys and stomach; whilst an excess of negative electricity is indicated in the liver and salivary glands. So far the hypothesis is consonant with facts; many more observations, however, must be made on the natural and diseased conditions of the secreting organs, before it can be substantiated.

"From experiments on the human subject, it would appear that the living body would be never in perfect equilibrium with those around it, were this not constantly maintained by free contact with them; thus, if two persons, both insulated, join hands, sufficient electricity is developed to affect the electrometer. Some electric disturbance is manifested by almost every individual, if it be carefully sought for. In men it is most frequently positive; and irritable men of sanguine temperament have more free electricity than those of phlegmatic character; whilst the electricity of women is more frequently negative than that of men. Some individuals exhibit these phenomena much more frequently and powerfully than others. There are persons, for instance, who scarcely ever pull off articles of dress which have been worn next the skin, without sparks and a crackling noise being produced, especially in dry weather; this may, however, be partly due to the friction of these materials on the surface and with each other, as it has been proved to be greatly influenced by their nature. The most

remarkable case of the generation of electricity in the human subject at present on record, is one lately related in America. The subject of it, a lady, was for many months in an electric state so different from that of surrounding bodies, that, whenever she was but slightly insulated by a carpet or other feebly-conducting medium, sparks passed between her person and any object which she approached. From the pain which accompanied the passage of the sparks, her condition was a source of much discomfort to her; when most favourably circumstanced, four sparks per minute would pass from her finger to the brass ball of the stove at a distance of one-and-a-half inch. The circumstances, which appeared most favorable to the generation of electricity, were an atmosphere of about 80°, tranquillity of mind, and social enjoyment; while a low temperature and depressing emotions diminished it in a corresponding degree. The phenomenon was first noticed during the occurrence of a vivid Aurora Borealis; and though its first appearance was sudden, its departure was gradual. Various experiments were made with the view of ascertaining, if the electricity was generated by the friction of articles of dress; but no change in these seemed to modify its intensity."

The conclusion, drawn by Dr. Wollaston from his experiments, that a knowledge of the qualities of the secretions is sufficient to determine the electrical conditions of the secreting organs in each case, would scarcely agree with the results of the researches of

Faraday, Becquerel, and De La Rive on the electrical disturbances produced by combustion; we should, according to the latter (which have proved that, in all kinds of combustion, as of Carbon, Hydrogen, Alcohol, &c., the combustible is negative, while the gas produced is positive,—the combination of the Carbon, carried in the venous blood of the lungs, with the Oxygen there inspired being said to partake of the nature of combustion), have the venous blood, at least, if not the lungs containing it, in a negative condition. That the electrical condition is not in living beings, uniformly the same in the different members of a species, we have satisfactory evidence supplied in the last extract from Dr. Carpenter's work on Physiology; we may reasonably infer, then, that as whole persons differ in their electrical states, so may their several parts and organs. Besides, as acids are said to be usually in a negative condition, the carbonic acid given off in the lungs would according to Becquerel, De La Rive, &c. be in an anomalous state; while the researches of Dr. Wollaston, leading him to a contrary view, would induce us to regard this excreted gas, according to the customary conditions of such substances out of the body, i. e. as negative, and the secreting organ consequently as positive. We repeat, however, that it is probable that the condition of internal organs is not uniform, as we know their secretions are not, in all states of health, temperament, &c. of the subject.

Electricians have described some very interesting and important manifestations of the development or disturbance of electricity in plants. Pouillet[1] has demonstrated by experiment that the ordinary processes of vegetable growth are attended with a manifestation of electricity. "Several pots filled with earth, and containing different seeds, were placed on an insulated stand in a chamber, the air of which was kept dry by quick lime. The stand was placed in connection with a condensing electrometer. During germination, no electric disturbance was manifested; but the seeds had scarcely sprouted when signs of it were evident; and when the young plants were in a complete state of growth, they separated the gold leaves of the electrometer half an inch from each other. It was calculated by him that a vegetating surface of 100 metres square in extent produces in a day more electricity than would be sufficient to charge the strongest battery; and he not unreasonably considers that the growth of plants may be one of the most constant and powerful sources of atmospheric electricity." Dr. Carpenter continues, "The disengagement of vapour from the surface of the leaves would alone be sufficient to produce it, as the fluid from which it is given off is always charged with saline and other ingredients; and the gaseous changes which are effected by the leaves upon the oxygen

[1] Carpenter, 'Op. Cit.,' p. 432.

and carbonic acid of the atmosphere, may be regarded as other sources of its development. Although it is not improbable that the electric state of plants will vary according to the nature of the changes which they undergo in relation to the atmosphere, yet their usual condition is negative; and a very ingenious theory has been erected by Dr. Graves upon this fact, to account for the violence of meteorological phenomena in tropical islands. The evaporation taking place from the surface of the sea, must tend to render the superincumbent atmosphere positively electrical; and that, too, with the most intensity during the day, at the very time when the agency of terrestrial vegetation is rendering the air over the land negatively electrical. 'How wonderful,' he continues, 'are the operations of nature! The peaceful and silent growth of a vegetation whose splendour fascinates the eye, developes an agency which, opposed to that produced by a rapid but unobserved evaporation from the surface of the surrounding ocean, tends to load the atmosphere with conflicting elements, from the depth of whose strife issues thunder proclaiming the approach of the hurricane and tornado.'" "There would appear to be much probability in Dr. Prout's speculation, that the small quantities of mineral bodies, usually regarded as accidentally present in the vegetable tissues, may have an important influence on their properties and actions. It has been shown by Sir J. Herschel, that a force of

50,000 times that of gravity may be instantaneously generated by the action of galvanism on an amalgam of mercury with a millionth part of its weight of sodium; and it cannot be denied, therefore, that the minutest admixture of ingredients may completely reverse the electrical, and, consequently, the chemical relations of large masses of organised matter."

From the experiments of Pouillet, we learn that growing vegetables are actively promoting those electrical conditions of the surrounding atmosphere, which issue in the disturbances of equilibrium manifested in storms, hurricanes, &c., at the same time that we know, how favorable such meteorological viscissitudes are to the reproduction of the lowest orders of the vegetable creation; thus we see the elements of these phenomena, acting and reacting, as in a circle, upon each other.

We must now recall the attention of the reader to some features worthy of remark in the history of Pestilential Cholera; and we will on this occasion admit its supposed origin at Jessore, as it may in all probability have arisen *de novo* at this place, though we do not believe it did so for the first time in 1817. Jessore or Moorley is the chief town of the district of Jessore in Hindostan,—the district of which it is the capital, extending into the Sunderbunds, or woody swamps. We shall give a description of the locality, from which, according to many authors, the Pestilence had its origin, in the language of Mr. Lyell. The

topographical character of Scinde, where in 1846,—at Kurrachee,—we have had occasion to remark, this Pestilence suddenly broke out in its most virulent form, is so similar, that we will first draw the reader's attention to it. "Scinde, like every other country of little altitude above the sea, and intersected by the numerous streams of a large Delta, is, from situation, and not from the sins of its inhabitants, subject to the usual consequences resulting from such situations. Periodically, are observed to be produced vapours and other emanations from the land and water, the effect of which upon animal life is frightfully destructive." The town of Kurrachee in Scinde, on a delta of the Indus or Sinde, is precisely similarly situated to Jessore, in the delta of the Ganges, these rivers bounding the promontory of Hindostan. While reading the extract we are about to give from Mr. Lyell, let it be borne in mind, that the habits of fungi are especially suited to the topographical characteristics of the delta of Jessore, while the incredibly prolific vegetation of the Sunderbunds, producing great electrical disturbance, would probably give occasional impulse to the wonderful reproductive powers of these beings. Mr. Lyell[1] says of the Delta, "Its base is two hundred miles in length, including the space occupied by the two great arms of the Ganges which bound it on either side. That part of the Delta which borders on the sea is composed of a labyrinth of rivers and creeks, all filled with

[1] 'Lyell's Geology,' vol. iv., p. 358, et seq.

salt water, except those immediately communicating with the principal arm of the Ganges. This tract alone, known by the name of the woods, or Sunderbunds, a wilderness invested by tigers and alligators, is, according to Rennell, equal in extent to the whole principality of Wales.

"So great is the quantity of mud and sand poured by the Ganges into the gulf, in the flood season, that the sea only recovers its transparency at the distance of sixty miles from the coast. The general slope, therefore, of the new strata must be extremely gradual.

"The immense transportation of earthy matter by the Ganges and Megna is proved by the great magnitude of the islands formed in their channels during a period far short of that of a man's life. Some of these, many miles in extent, have originated in large sand-banks thrown up round the points at the angular turning of the river, and afterwards insulated by breaches of the stream. Others, formed in the main channel, are caused by some obstruction at the bottom. A large tree, or a sunken boat, is sometimes sufficient to check the current and cause a deposit of sand, which accumulates till it usurps a considerable portion of the channel. The river then borrows on each side to supply the deficiency in its bed, and the island is afterwards raised by fresh deposits during every flood. In the great gulf below Luckipour, formed by the united waters of the Ganges and Burrampooter (or Megna), some

of the islands, says Rennell, rival in size and fertility the Isle of Wight. While the river is forming new islands in one part, it is sweeping away old ones in others. Those newly formed are soon overrun with reeds, long grass, the Tamarix Indica, and other shrubs, forming impenetrable thickets, where tigers, buffaloes, deer, and other wild animals take shelter. It is easy, therefore, to perceive, that both animal and vegetable remains must continually be precipitated into the flood, and sometimes become imbedded in the sediment which subsides in the delta.

"The geologist will not fail to observe how peculiarly the habits and distribution of these saurians expose them to become imbedded in the horizontal strata of fine mud, which are annually deposited over many hundred square miles in the Bay of Bengal. The inhabitants of the land, which happen to be drowned or thrown into the water, are usually devoured by these voracious reptiles; but we may suppose the remains of the saurians themselves to be continually entombed in the new formations.

"*Inundations.*—It sometimes happens, at the season when the periodical flood is at its height, that a strong gale of wind, conspiring with a high spring tide, checks the descending current of the river, and gives rise to most destructive inundations. From this cause, in the year 1763, the waters at Luckipour rose six feet above their ordinary level, and the inhabitants of a considerable district, with their houses and cattle, were totally swept away.

"The population of all oceanic deltas are particularly exposed to suffer by such catastrophes, recurring at considerable intervals of time; and we may safely assume that such tragical events have happened again and again since the Gangetic delta was inhabited by man. If human experience and forethought cannot always guard against these calamities, still less can the inferior animals avoid them; and the monuments of such disastrous inundations must be looked for in great abundance in strata of all ages, if the surface of our planet has always been governed by the same laws. When we reflect on the general order and tranquillity that reigns in the rich and populous delta of Bengal, notwithstanding the havoc occasionally committed by the depredations of the ocean, we perceive how unnecessary it is to attribute the imbedding of successive races of animals in older strata to extraordinary energy in the causes of decay and reproduction in the infancy of our planet, or to those general catastrophes and sudden revolutions resorted to by some theorists.[1]" In

[1] Dr. Parkes, in an appendix to his work, gives a sketch of the Tenasserim Provinces, in which he informs us, Pestilential Cholera first appeared, and in which he has recently witnessed its phenomena. He describes them as composed of alluvial plains watered by large rivers loaded with debris, and collecting innumerable tributary streams,—the alluvial soil being several feet thick. Consequently the whole country is covered with the most exuberant vegetation, growing up with incredible rapidity; so that "a deserted village is overflowed by the forest like the waves of the sea, in the course of two wet seasons, and the traces of man are buried by the exuberant productions of nature." Heavy mists

this extract from the work of Mr. Lyell, we find sufficient evidence of the fitness of Jessore,—as eminently qualified by its abundant, and constantly forming, deposit of decaying animal and vegetable matter contained in its accumulations, to become a hot-bed for Fungi; and the germs of these being taken up by evaporation (Fries), and perhaps attracted in thick cloudy masses by clouds in an opposite state of electricity, may have caused phenomena like that described in the narrative of the invasion of Kurrachee by the Pestilence in 1846; the germs being deposited over any particular locality where an electric equilibrium was restored. We do not pretend to lay down a law for the regulation of effects, like those which form the subject of the present enquiry; but it would be difficult,—it might be wrong,—to close one's eyes to similitudes and analogies, which may ultimately lead to actual de-

hang over the plains for a considerable part of the day during certain seasons, while "malignant remittent fever" prevails. At another season it appears that meteorological phenomena recur with daily regularity—"morning and evening, dark lowering clouds surround the horizon, accompanied with lightning and low rolling thunder." In July,—the thermometer ranging from 78° to 83°,—the atmosphere is charged with watery vapour, and "leather is thickly mildewed in twenty-four hours; meat taints with the greatest rapidity, and it is impossible, without the greatest care, to preserve dried plants, or zootomical preparations" (p. 246).

In these provinces dysentery, bilious and malignant remittent fevers, and Cholera frequently prevail to a great extent. And, if there be any truth in the opinions set forth in this volume, we should expect that in a locality, so well adapted to the production of Fungi, these diseases would from time to time be rife.

monstration of the agents, by which these effects are produced. It must not be overlooked that these proceedings have been taking place in a climate, whose inhabitants are regarded as possessed of a low state of vitality,—a climate always relaxing and enervating, and requiring but little additional aid from meteorological changes to render its people all but resistless to a morbific virus of any kind. The experiments of M. Donné tend to show that the different organs or viscera of the human body may be in different electrical conditions; while it has also been shown by experiment that persons are, wholly, in one or other of the electrical states, but that according to temperament, state of health, or other circumstance, they may be either positive or negative; and therefore it is probable, that the various electrical states of viscera will be found to differ accordingly;—the lungs of one may be negative, while those of of his neighbour or kinsman, shall be positive. To revert to the chemical lecture-room illustration;—we shall now have lungs in such electrical state as to attract the sporidia (germs) of fungi floating in the atmosphere, while the lungs of others, fortified by the artificial aid of stimulants, or by natural magnanimity, or great robustness of constitution, shall be able to repel the germs; and hence we shall find among persons, equally exposed to contamination, some falling easy victims to the Pestilence, while its assault on others shall be harmless.

We have seen that the germination and repro-

duction of Fungi require favorable concurrent circumstances, without which their sporidia may long remain dormant and inactive. In our present ignorance we must be content with a very limited acquaintance with such necessary conditions; and we must allow that such concurrent causes *may*, after long suspension re-appear, and assist to bring about a re-appearance of pestilence. If so, the argument of Dr. George Budd, in favour of the non-contagiousness of Pestilential Cholera, founded upon the apparently causeless outbreak of that disease on board the Dreadnought Hospital Ship, and almost simultaneously in the Marylebone Infirmary, in 1837, after some years' cessation, must fail; because the germs of a fungus might lie wrapt up in some clothing or shut up in some locker, or even lie in the cracks and crevices of walls and floors, not being in sufficient numbers as to possess the required intensity (*under ordinary circumstances*) for the generation of the disease; and yet on the appearance of sufficiently favorable auxiliary conditions, meteorological or other, they might be sufficient to accomplish their end. The coincident occurrence of the disease in the Dreadnought and in the Marylebone Infirmary admits, in this way, of an easy and natural explanation.

Before we leave this very interesting part of our enquiry we must allude to another curious coincidence in the appearance of fungi and of the symptoms of Pestilential Cholera. It is familiar to every one, that

our best known fungi make their chief growth during the hours of darkness. And we find Dr. George Budd emphatically insisting on the remarkable uniformity, with which the symptoms of Pestilential Cholera showed themselves at night; he says[1] these "almost always first show themselves during the period from sunset to sunrise," and again (p. 118) he repeats this remark—"Whatever be this agent, the almost constant accession of the violent symptoms during the night renders it probable that its influence is then more powerful than by day." If the speculations of some scientific minds on the nature of light, in which it is regarded as a modification of electricity, should receive confirmation, the circumstances just adverted to might be explained on the supposition that the withdrawal of the stimulus of light, or, in other words, the change of electrical condition produced by such withdrawal, would be favourable to the vegetation of the germs of fungi, to which we attribute the phenomena of the Pestilence. The peculiarity in the period of the accession of the symptoms of the disease would in this manner be accounted for. Moreover, the extreme rapidity, with which Pestilential Cholera has run its course in some persons, is analogous to what we see in some processes of fermentation, taking place under great meteorological disturbance; the intense

[1] 'Op. Cit.,' vol. iv., p. 110.

operation of the virus as witnessed at Kurrachee in 1846 (and indeed almost every where observed in this disease), and reported in the 'Bombay Times' in the following language,—"So sudden was death with some, that they were seized, cramped, collapsed, dead, almost as fast as I have written the words," being, in no other operations with which we are acquainted, so nearly imitated, as in the instances in which simultaneously with great electrical changes, during thunderstorms, we have an acetous fermentation completed within a very short, perhaps inappreciably short, space of time. Both are conformable with the known habits and properties of Fungi. Another proof of the analogy exists in the singular phenomenon of the animal heat in Pestilential Cholera often *rising just before death, and continuing to do so for some time after.* Our doctrine will, we are confident, alone supply a satisfactory explanation of this.—It will be remembered that the Fungi attacking the West Indian wasp, and the silk worms in the South of France, grew more rapidly as the resistance of vitality was diminished, or withdrawn. Then, as we know that all the fermentations are accompanied by more or less sensible development of heat, we should expect that as any one of these occurring in the human body became more vigorous, by the more rapid vegetation of Fungi as life ebbed away, the temperature would of necessity increase. And such is the case.

The convertibility of Fungi and allied species is another point, not only singular and interesting in itself, but one that may grow into practical importance, should the views of the author be hereafter confirmed. An alliance between the several sorts of Pestilence, known in this country in the time of Sydenham, was evidently supposed by him to exist; as is attested by his remarks on Pestilential Fever in connection with Plague, and those on the great resemblance between the latter and Erysipelas. Mr. Adams, the learned translator of, and commentator on, the works of Paulus Ægineta does not hesitate to affirm that several pestilences, and includes in the list 'The Plague' and 'Pestilential Cholera,' are one in nature and cause, being merely varieties of a species. In some experiments made by Dutrochet,[1] he "has ascertained that a simple solution of Albumen in distilled water may be kept for a year without giving rise to any fungoid production; and that portions of such productions, introduced from without, do not extend in it. But, if the solution be acidulated, a species of the genus *Monilia* very shortly appears; whilst, if a small quantity of alkali be added, a kind of *Botrytis* developes itself. But, on the other hand a solution of fibrine with alkali produced *Monilia*; and water distilled over lettuce, and acidulated with phosphoric acid, gave rise to *Botrytis*; so

[1] Carpenter, 'Op. Cit.,' p. 72.

that the form which the fungous vegetation assumed was not due to the *direct* influence of acids and alkalies respectively. Such Fungi, when growing in water, present a very *confervoid* aspect, their cells being elongated, and their branches spreading without fructification to a great extent; so that even experienced Mycologists have been deceived as to their nature." In addition to the above we have the discovery, made by Professor Henslow, of Cambridge, that the rust of corn (*Uredo rubigo*), is only an earlier form of mildew (*Puccinia Graminis*), the one being produced from the same fructification as the other. And it is observed by Dr. Carpenter[1] of Lichens,—"There seems, indeed, from late observations, to be nearly the same uncertainty of form among the Lichens, as prevails in the Fungi; the same germs presenting many different appearances, according to the mode and degree of their development. The sporules which are developed from the shields, appear capable of reproducing the characteristic form of the species; whilst the powdery matter, which is frequently produced in little cup-like bodies raised above the surface of the thallus, as well as the separated particles of the plant itself, appear capable of independent existence, in various less definite forms."

In M. Simon's 'Animal Chemistry' diseases are classified according to the excess or diminution of

[1] 'Op. Cit.,' p. 76.

fibrine in the blood, into—1st, Hyperinosis; 2nd, Hypinosis; 3rd, when there is an impoverished state of the blood, Spanæmia; and 4th, when matters, foreign to the healthy composition of the blood, are to be found in it, it is named Heterochymeusis. It is in the last class that Pestilential Cholera is placed, on account of the presence of urea in blood taken from persons who have suffered an attack of this disease; but the blood may have previously (during a stage of predisposition, however brief) been in the state of Hyperinosis or Hypinosis, and so have formed some particular fungus for the growth of which one of these states might be peculiarly favorable,—the preponderance of fibrine with alkali in the blood, fitting it for a *monilia*, while an excess of albumen with alkali would adapt it to the production of *botrytis*. But we may stand clear of speculation in assuming, that as each decomposing organic substance has a fungus peculiar to itself, so the blood of the first Cholera patient, in all probability, if it harboured a fungus at all, contained one possessed of some characteristic by which it was distinguishable from all others, and would in a similar nidus give birth to others alike characterised; and thus become communicable, as mushroom spawn is from one depôt of it to several beds or shelves in a mushroom-house.

By way of recapitulation, we have to remind our readers, that in this division we have endeavoured

to show, that, as Fungi are meteoric, so may Pestilences, and Pestilential Cholera in particular, be considered too; that the sporidia (germs) of Fungi, being possessed of a peculiar electrical condition, would probably be attracted by the lungs of some persons, and repelled by those of others,—persons and their several parts being shown to possess, each its peculiar state of electricity, varying probably with vicissitudes of electrical condition, ever and anon occurring in the atmosphere; that active vegetation is highly conducive at least to the development of those conditions on which meteorological disturbances depend, and that such active vegetation exists even to exuberance in the climate of Jessore (and many other places in India), in whose delta are to be found all the elements that could compose a forcing bed for Fungi,—a climate also equally conducive to the production of diseases; that Kurrachee, in the delta of the Indus, on the western boundary of Hindostan, in all respects resembling Jessore, had been similarly distinguished by apparently giving origin *de novo* to Pestilential Cholera, its sudden outbreak being ushered in by remarkable meteorological appearances; that dormant germs (sporidia) of Fungi called by favorable atmospheric conditions into operation, though after long inactivity (like grains of wheat enclosed with Egyptian mummies), were probably the efficient causes of the reappearance of Pestilential Cholera on board the Dreadnought hospital ship, off Geenwich;

and, simultaneously, in the Marylebone Infirmary, in 1837,—the Pestilence having previously prevailed in both those places in 1832; that Cholera develops itself, as do Fungi, at night,—probably from the existence during the hours of darkness of an altered state of electricity; that Fungi are convertible, change of circumstance converting one variety into some other, so that the germs of a particular variety, under the prevalence of conditions highly favorable to their development in human blood, might in that nidus produce a distinct variety, capable of reproducing itself in a similar nidus, without the concurrence of those meteorological phenomena which assisted at its birth; that moreover the germs of one fungus *might* possibly, under varied circumstances, give rise to more than one kind of pestilence, some authors considering several kinds of pestilence as mere varieties of each other; that the fact of Fungi being of different kinds according to the nidus, as proved by the experiments of Dutrochet and others (the blood being found to vary so as to present conditions favorable to more than one kind), supports the notion that the change of the blood to one of such conditions by means of predisposing causes, may account for the yielding of some constitutions to the disease, whilst others successfully resist it.

We have in this division,—of the subjects, treated in which, we have just given the heads,—attempted to exhibit the extraordinary coincidences in phenomena

known to mark the development of Pestilential Cholera, as also that of Fungi; and have attempted to show in what way the latter might possibly establish themselves in the human body,—the manner in which disease would result from their agency, when so established, having been pointed out in the previous chapter. Similitude, however, is not sameness; and whatever satisfaction we may ourselves derive from the close resemblance of some of the features of these two facts in nature—Pestilential Cholera and Fungous vegetation, we must leave it to our readers to form their own opinions, whether this justifies the belief of its constituting a strict family likeness. Some of "the circumstances which probably concur to produce from the germs of fungi the effects of Pestilential disease, with facts to prove that a 'variety of nidus causes a variety of fungus," appear to our minds strongly to favour the analogy.

CHAPTER XI.

IDENTITY OF REMEDIES RECOMMENDED IN PESTILENTIAL CHOLERA WITH ANTI-FUNGIC AGENTS.

5th.—We are next to give our attention to some points in the treatment, preventive and curative, in order to show "that the prevention or destruction of fungous germination (vegetation), and the consequent catalytic actions, is effected by the very medicinal agents, recommended on the highest authority in the prophylaxis and curative treatment of Pestilential Cholera." We shall preface our remarks by quoting an opinion, derived by us, we believe, from Dr. Holland's excellent book ('Notes and Reflections'), that in obscure cases of a gouty nature the diagnosis will be cleared up by the success, or otherwise, of the gout remedy—Colchicum; and Dr. Marshall Hall has applied a similar rule, in his recommendation of bleeding as a means of diagnosis. Shall we be departing from the real track of philosophical induction, if following the example of such high authorities, we resort to similar reasoning in the present instance?—Or, if, on establishing the fact, that fungous vegetation and the operation

of the pestilential virus are prevented and destroyed by the same identical agents, we should give our assent to the conclusion, that, besides the identity of remedies, there is an identity of cause?

The remedies, agreed upon by most authorities on this disease, as applicable in the earliest stage of an attack, are stimulants and astringents. The first morbid impression—one of depression—is, we are assured, removable in many cases by *powerful stimulants and tonics* (p. 96). Aromatics and essential oils with astringent mineral substances,—acetate of lead, mercurial preparations, sulphates of zinc and copper, and tartrate of antimony and potash,—are recommended by practitioners most worthy of our confidence. The validity of our doctrine,—so far as it can derive support or receive refutation from treatment,—must do so from that part of it, which is administered with a view to counteract the first impression of the virus, and to destroy this before the disease has so far proceeded, as, by putting a stop to the power of absorption of medicine, to defy all remedies.

Professor Graham informs us, that many substances are capable of preventing the several kinds of fermentation, which, we have reason to believe, all originate in fungous vegetation; we hope to be excused for repeating an already quoted passage;—he says,[1] "The action of *yeast* and all other ferments

[1] 'Op. Cit.,' p. 724—5.

is destroyed by the temperature at which water boils, by alcohol, by acids, *salts of mercury*, sulphurous acid, chlorine, iodine, bromine, by *aromatic substances*, *volatile oils*, and particularly empyreumatic oils, *smoke* and a decoction of coffee, these bodies in some cases combining with the ferments or otherwise effecting their decomposition." As regards the preparations of mercury, they are, according to Professor Graham, capable of destroying the action of ferments; and one of them, we know, is destructive to cryptogamic vegetables,[1]—"Bichloride of mercury is equally poisonous to cryptogamic plants. Hence vegetable tissues soaked in a solution of it are no longer adapted for the development of the *Merulius lachrymans*, and of other fungi known under the name of the *dry-rot*. This in fact is the principle adopted by Mr. Kyan for the preservation of timber, and which is now practised by the *Anti-dry-rot Company*." The acetate of lead was found by Marcet[2] to be injurious to vegetation; but little is known, however, of its action on them. The compounds of zinc being "somewhat analagous to those of copper," and other metals, it is not unlikely that sulphate of zinc may be anti-fungic. Of antim. tartariz. we read in Dr. Pereira's work,[3]—"Emetic tartar acts as a poison to plants, &c." While of the sulphate of copper he says,—"It is poisonous to plants, (Decandolle,

[1] Pereira, 'Mat. Med.,' vol. i., p. 475.

[2] Pereira, 'Op. Cit.,' vol. i., p. 506. [3] 'Op. Cit.,' vol. i., p. 410.

Phys. Vég. 1335): hence its use in preventing dry rot (*Merulius lachrymans*) by soaking timber in it, according to Mr. Margary's patent; and in destroying or preventing the smut (*Uredo segetum*), or bunt (*U. caries*), in corn, by immersing the grain in a weak solution of it: the solution is not made sufficiently strong to injure the seed." On the subject of the sedative action ascribed by Dr. Billing to the metallic salts, recommended in the treatment of Cholera, we seem but little to understand in what that sedative action consists. But as the usual indication for their employment, namely over-action, whether inflammation or simple hyperæmia, seems to consist mainly in an altered attraction between the blood and tissues containing it, in the inflamed part, so producing a remora in the capillaries, the facts, communicated to us in the work of M. Simon, may help to explain it, at any rate pointing out one way in which the beneficial operation of sedatives in inflammation may be produced; he remarks[1]—"The following metallic salts impede the coagulation of the fibrine; sulphate of copper, ammoniaco-sulphate of copper, sulphate of the protoxide of iron, chloride of iron, ferro-cyanide of potassium, acetate of lead, and tartrate of antimony and potash;" and in a note to this passage he adds,—"Schultz remarked that the hydrochlorate of ammonia, sulphate of potash, and sulphate of magnesia, retain

1 Simon, 'Op. Cit.,' vol. i., p. 116.

the blood in a state of fluidity, and that even the addition of a large quantity of water does not produce coagulation. After the addition of sulphate of soda, the blood could only be prevented from gelatinising by constant stirring, a step that was not requisite with the other salts." These results made known to us by M. Simon may, as already said, help to give us some idea of the *modus operandi* of tartar emetic and Epsom salts in producing their sedative effects in states of over action; but we cannot suppose that in Pestilential Cholera these medicines produce their benefit in such way; and the fact of more success attending the practice of Dr. Billing, when he had less frequent recourse to bleeding,—a sedative remedy,—rather favours this opinion. The efficacy in Pestilential Cholera of tartar emetic and other metallic salts, and perhaps the common neutral salts too, seems to us to be attributable, with greater probability, to their power of destroying fungus germination.

This brief appeal to the remedial treatment of Pestilential Cholera is sufficient to show that such medicines, as are possessed of any reputed efficacy in controlling the morbid operation of the virus of this disease, are precisely those, which our best chemists have ascertained to be possessed of the power to frustrate and stop the action of ferments, and to prevent and check the ravages of destructive Fungi.

Conclusion of the Argument.—Having, as we trust,

satisfactorily displayed the fitness of Fungi for a habitation within the human body;—their agency in many subtle processes bearing an analogy to some of the phenomena of Pestilential Cholera;—their capability also to produce such phenomena;—the circumstances which probably concurred to such production, and the convertibility of these organisations;—the prevention or destruction of them and their effects by many of the identical medicinal agents of best repute in preventing and curing Pestilential Cholera;—we come by induction, to the conclusion that Fungi constitute the morbific agent in the propagation and diffusion of this Pestilence.

It now only remains for us to apply this doctrine to an explanation of the prevention and treatment, as well as of the phenomena of Pestilential Cholera, which we shall do in the next—the concluding—chapter.

CHAPTER XII.

SUMMARY OF THE AUTHOR'S VIEWS OF PATHOLOGY, WITH DEDUCTIONS FOR PREVENTION AND TREATMENT.—CONCLUSION.

The facts, recorded in the history of Pestilential Cholera and other pestilences, have convinced the author, that Cholera was not unknown previous to the present century; though our increased interest in, and greater communication with eastern countries, within the last fifty years, has brought to our knowledge circumstances, with which we were not previously acquainted. It is, however, highly probable, that this pestilence has not always conformed to one type,—that it has not uniformly submitted to be limited by geographical boundaries; but that like some diseases, universally allowed to possess contagiousness, increased communicability has from time to time been imparted by rarely recurring concurrent circumstances.

That Pestilential Cholera is not identical with the sporadic English Cholera, we do not believe that any one will dispute; while we are quite prepared to admit, that the two are naturally allied, and that even in this country the peculiar virulence of Pesti-

lential Cholera may be manifested under peculiar circumstances, as witnessed in the disease at the Clapham School, reported by the late Dr. Hope.

As regards the contagious nature of Cholera, we are disposed to the belief, that, had the disease been diffused only by atmospheric agency, irrespective of that of the human body, it would not have made its way so slowly, nor by such a gradual progression in certain directions; in short, its dissemination would have been irregular and apparently capricious. At the same time we are convinced, that in eastern climes the disease often does arise *de novo;* and in all probability the elements of the disease are annually produced in certain predisposed localities. This would tend materially to mask the display of contagious manifestations, even should they be at work. And, indeed, we have seen that even Mr. Jameson, an anti-contagionist, leans to the conclusion, that the disease, if not communicated from individual to individual, may nevertheless be so from one body of men to another.

It appears reasonable to infer from the statements, made in previous chapters, that an electrical condition of a certain kind must concur with the presence in the atmosphere of the morbific germs to produce their effects. Such condition, we presume, must be rather that of the individual, than of the atmosphere surrounding him. It seems also probable that the composition of the blood, in regard to the relative

proportion of its protein constituents, and especially its fibrine, may determine the morbid action. In those persons, who, though exposed to the cause, escape the effects of the Pestilence, it may be that the absence of such conditions serves for their protection. How far the wretched circumstances of the poor, and the squalid misery of their dwellings, with the constant accumulation of filth in and around them, conduce to the attraction and reproduction of the germs of a pestiferous fungus, we may easily conceive from what we know of their predilection for localities so circumstanced; but whether it is that the filthy accumulations contribute any element to the production of disease, or whether—co-operating with their other circumstances to lower the vitality of those who inhabit such places,—they predispose these to attract and develope the germs of disease, we know not.

The medical attendants and others, occupied about Cholera patients, were no doubt in most instances fortified by stimulants or tonics against an attack; and unless they were compelled to remain in low moist[1] situations (for moisture seems quite as indispensable to the propagation of Pestilential Cholera,

[1] Dr. Parkes says,—"During the progress from the north towards the south, Cholera, as already stated, attacked chiefly or exclusively the towns and villages stationed in low marshy places, on the banks of rivers, or on the shores of the sea" ('Op. Cit.,' p. 160). Dr. Parkes also gives other instances, illustrative of the same view of the indispensable necessity of moisture.

as we know it is to the development and diffusion of Fungi), they might in a majority of instances escape. Continued residence in a moist atmosphere, which is a good conductor of electricity, must materially tend to keep down the electrical stamina of the body, and not improbably in this manner assists in overcoming the resistance made by the constitution to the effects of pestilential agents. To this concurrent cause of the disorder the poor in low and ill-ventilated situations are continually exposed.

We see no reason for supposing the necessity of immediate intercourse between infected and uninfected persons or places for the diffusion of this pestilence, if it is contagious; for we do not see why the germs given off by exhalations from the bodies of the sick, and their ejected matters, passing by evaporation into the atmosphere, should not be carried by it *over cordons sanitaires*, and into vessels performing quarantine; but then the atmosphere must be in a favourable state, most probably moist and not quite motionless, and the persons attacked must have been predisposed. Why, we may ask, should not the germs of one disease be diffused by the atmosphere over considerable space, as are those of others, and as we are sure those of Fungi are? Our belief is that Pestilential Cholera is contagious; but that it requires certain concurrent conditions, in the absence of which the phenomena of contagion will be also absent.

The conclusion, we have arrived at as to the nature of the cause of Pestilential Cholera, is, that it is a minute fungus, probably resembling the *Torula cerevisiæ*,—having ascertained that, among known agencies that have been suspected of generating this disease, no other can be found, which in its habits is capable of conforming with the circumstances, observed in the origin, diffusion, and morbid phenomena of the disorder;—no other could exhibit those astonishing habits of uniformity under the utmost variety of circumstances witnessed in Cholera. The fungus, as it exists in the blood, most likely does not resemble that, which produced its germs.

Pathology.—Our opinion is, that the germs of a fungus are absorbed through the lungs into the blood of bio-chemically (electrically) predisposed persons; that a process of germination, and consequent catalytic fermentation, is immediately established; the composition of the blood instantly begins to undergo a change, the heart is less stimulated by blood insufficiently oxygenated, and nutrition—and consequently the extrication of animal heat—is checked throughout the capillary circulation; and coldness and lividity are thus produced. [Whether the fermentation be of the kinds, with which chemists are acquainted, must be determined by future observation and experiment;—it certainly in its effects, bears some resemblance to two of them—the putrefactive and the viscous or lactic. The fact of

the disease having been created in the Clapham school by the opening of a cesspool, from which abundance of the germs of the fungus of putrefactive fermentation would be liberated, may favour the assumption of the consequent fermentation being putrefactive. But the observation of M. M. Boutron and Fremy, already related (p. 136), that from one ferment, capable af assuming several forms, we may have as many kinds of fermentation,—agreeing also with the known property of convertibility, by change of nidus, of Fungi (shown at p. 186),—would induce us rather to suppose, that the consequent fungus and its fermentation might not exactly resemble any of our known fungi or fermentations.] An effort appears to be made in the constitution to rid itself of the morbific agent by directing it, as is usual in diseases, and also in the discharge of medicinal substances, to some excreting surface. In this case the mucous surface of the alimentary canal by profuse discharges endeavours to expel the morbid matter which has been directed to its surface. It is here, on the mucous membrane, that there appears to be formed, in an early stage—the cases seldom being sufficiently protracted for a more mature development,—a nidus for the growth of Fungi; this consists of the Protein deposit, of the nature of which pathologists are not agreed, found in the alimentary canal, and which seems to resemble the albuminous crusts which form the nidus of the Fungus of Aphthæ (Berg).

The cramps are referred by some to an irritation of the excito-motory nerves, distributed on the alimentary mucous membrane, by the matters poured into the canal: they also in some degree resemble the convulsive spasms produced by excessive hæmorrhage, —a large proportion of the blood in Cholera being virtually, though not actually, withdrawn from the circulation. This virtual loss of blood, with the contamination of that which does circulate, appears to us more rationally to account for the consecutive fever, than the presence of urea[1] in the blood can do; the symptoms being precisely those, which might be compounded from the reaction after hæmorrhage with a circulation of corrupted blood, the average duration of the fever also indicating, that it consists essentially of mere reaction. The coldness, already explained, often ceases before death, the warmth returning and even increasing after death;[2] this we believe to result, as before stated, from the more rapid and extensive vegetation of fungi, as less opposition is made to it by the vitality of the frame;— and is explicable in the same way that the sensible heat extricated in other processes of fermentation (fungous vegetation, as in the growth of common

[1] Dr. Parkes also appears to combat this view of the cause (by urea) of the consecutive fever ('Op. Cit.,' p. 74—75).

[2] In a paper by Dr. Black, of Manchester, in the 'Provincial Medical and Surgical Journal,' January 26th, 1848 (the very day this sheet was written), it is stated,—"The heat of the corpse re-appeared in several cases from two to six hours after death, and it often continued for twenty-four hours," &c.

green mould, when the matter, in which it grows, becomes very warm) may be explained.

The "viscid," "oily," "ropy," and "tar-like" appearance of the blood would probably result from either the common viscous or lactic fermentation, or from a modified putrefactive fermentation, resembling that described by Professor Graham, as taking place in the German sausage (quoted at p. 137 et seq.). It may however be of a kind dissimilar to any of our known fermentations.

The secondary dysentery we regard as probably the result of Fungi, growing in the plastic exudation,—which is described as being often so closely adherent to the mucous membrane as to be with difficulty separated, and so, much more resembles the proteine crusts of aphthæ, than a mere deposit from an excreted fluid. The common Dysentery of the tropics, also, is not improbably caused by the parasitic growth of Fungi. This opinion receives confirmation from the observation by Dr. J. H. Bennett (adverted to at p. 121), of a confervoid fungus in the exudation discharged in a dysenteric case.

That the lungs should be frequently found congested, or inflamed, in cases of protracted Cholera, we should be prepared, from our experience in other epidemic disorders, to expect. In plague, we are told by Sydenham, that there is "violent inflammation of the lungs;" in malignant typhus congestive inflammation of the lungs is commonly looked for; in

other diseases, too, it is a common complication. This affection of the lungs is not surprising, when we consider that the first germs, and their first morbid impressions, are received in these delicate organs; and that any serious alteration of the composition of the blood, contained in them, might readily produce that remora, which constitutes congestion; and how often congestion runs on into inflammation is well known to practical men.

The suspension of secretions is due to the altered quality of the blood, as well as to its obstructed circulation.

Treatment.—1st. *Preventive.*—The ancients seem to have had ideas of the nature and treatment of Pestilences, almost as accurate as our own have hitherto been. Hippocrates, like Acron of Agrigentum, is said to have changed the morbific state of the atmosphere at Athens by kindling fires. Pliny[1] says of fire as a corrective of the atmosphere, "Est et ipsis ignibus medica vis. Pestilentiæ, quæ solis obscuratione contrahitur, ignis suffitu multiformiter auxiliari, certum est. Empedocles et Hippocrates id demonstravere diversis locis." For the same purpose Simeon Seth proposed fumigations with frankincense; and Herodian states that similar practice was recommended in his day. This empirical use of fires has now received the support of science, for

[1] 'Paulus Ægineta,' by Mr. Adams (Syd. Soc.), vol. i., p. 274.

the reader will recollect, that the poisonous properties of the Wirtemberg sausage are attributed by Professor Graham (quoted at p. 138) to their being "*smoked* too late or not sufficiently:" at another place he mentions '*smoke*' (quoted p. 194) amongst the agents enumerated as capable of preventing the several kinds of fermentation. These recommendations of the ancients, where practicable, might be advantageously adopted now.

The best qualified observers of the phenomena of pestilential disease believe, that the morbific matter, suspended in the air, is inhaled with it by the lungs, and is thus admitted into the circulating blood. Whatever antidote can be administered to the poison so inhaled had better, therefore, be taken in in the same manner. Now amongst the agents described by Professor Graham (quoted p. 194) as preventive of fermentation, and also familiarly known to prevent the growth of mould and mildew (fungi), organisms resembling those which effect fermentation, are the aromatic and essential oils. The author therefore proposes, that by a simple contrivance,—a kind of respirator of double wire gauze,—a porous substance of woollen texture imbued with one of the essential oils (probably cloves will be found best), should be so placed, as that the vapour should be inhaled, and thus, entering with the morbific fungous germs, will, it is hoped, effectually prevent their vegetation, and consequent morbid effects. This practice will

of course require caution as to the quantity of essential oil employed. In addition to this, the use of aromatics,—and none better than cloves,—in food and beverage, should, during the prevalence of pestilence, be more than ordinarily abundant. Tonics, and especially sulphate of copper — eminently antifungic, as well as an invaluable remedy in chronic diarrhæa,—may be also employed as prophylactics. Stimulants (wine or other beverage mulled) taken internally may be used with advantage by those exposed to the morbific virus; and are especially necessary to repel the first impression made by such virus (as quoted from Dr. Copland at p. 96).

2nd. *Curative.*—This, to be of any efficacy, must be practised while absorption of medicine from the stomach and alimentary canal can take place, which is found too often to be impracticable in the advanced stages of the disorder. We should ourselves give the sulphate of copper with stimulants *and aromatics* to make it sit on the stomach: nor should we, except in persons so robust and plethoric, as to endanger their convalescence with inflammatory sequelæ, have recourse to bleeding. The use of astringents with aromatics,—by friction with essential oils in embrocations, by aromatic fumigation, after Simeon Seth and, recently, Dr. Copland, and by aromatic inhalation as now proposed, as well as by the mouth,—is indicated. Any of the methods in use may, with apparently equal advantage, be employed in the

advanced stages, and indeed in the early ones of severe cases. We again repeat, that the attention of medical men must be directed rather to the prevention than the cure of this Pestilence, except in its mildest forms, in many cases of which probably a fatal issue would not be the result, were they left solely to nature. Prevention may, we trust, be confidently expected, from an application of the means deducible from science, and which we have striven in this work to exhibit.

Conclusion.—Conscious that the instruments, employed in exposing to view the previously concealed agents in the production of Pestilential Cholera, have been, from want of practice, unskilfully used, it is, nevertheless, hoped that this effort will not be totally unproductive of benefit. It would be out of place here to enter at length into speculations on the causes of other epidemics. But we may be permitted to express an opinion, that many of our known epidemics have their origin in fungous vegetation; some of them, like Influenza, acting immediately upon human beings,—others requiring (except in localities possessing those constituents requisite for a development *de novo* of the morbific virus, as is probably the case with Cholera in India), the mediate action of the human body,—thus constituting an infectious disease. That yellow fever and other fevers of tropical countries depend, like Cholera and Dysentery, on the vegetation of Fungous ferments, we have little doubt:

while we expect it will ere long be shown, that many of our eruptive diseases spring from a like origin. Even Scabies, with its *acarus*, is probably an affection produced by the development of a fungus, on which the *acarus* feeds; just as we have seen an *acarus* feeds on ergot, and as, we think it probable that, the *aphis vastator* (Smee) does on the *Botrytis infestans*—the fungus to which the potatoe disease has been ascribed.

THE END.

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